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ABSTRACT

This document reports the results of an examination of the external and internal environments of the Internal Revenue Service (IRS) and the most promising technological tools and methods to create the training system capabilities the IRS will need in the future. Following an executive summary, chapter 1 describes how the document was developed. Chapter 2 describes current IRS training. Chapter 3 explains two factors--the changing workplace and work force--that affect IRS training. Chapter 4 discusses the technological, methodological, and organizational issues that affect IRS training, including computer-based training, artificial intelligence, hypertext and hypermedia, embedded training, asynchronous computer conferencing, one-way videoteleconferencing, two-way digital (compressed) videoteleconferencing, CD-ROM (Compact Disk Read-Only Memory), DVI (Digital Video Interactive), compact disk interactive (CD-I), interactive videodisk, trends in technology, educational methodologies, and organizational issues. Chapter 5 describes a workshop for IRS training managers and functional managers that provided the managers' views on the issues, possibilities, and problems identified during the project that produced this document. A 14-page bibliography is included in the document. An appendix lists information on the task force that guided the document's development. (CML)

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TRAINING 2000

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The leadership, resources, and commitment to the idea's fulfillment were provided by Benjamin R. Dadd, Jr., Chief, Office of Training Program Management.

Valuable insights and focus were obtained from the IRS training and functional managers who participated in the workshop held in Leesburg, VA, November 28-30, 1988. Their names and titles are listed in the Appendix.

Training 2000 was prepared by the Advanced Instructional Systems Section, Office of Training Program Management, Human Resources Division, with support in part from the Allen Corporation under the OPM Contract # OPM-87-9002. Those responsible for the preparation are:

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Executive Summary

IRS TRAINING 2000

Technological advances that are transforming the workplace, and demographic trends that are changing the nature of the workforce, will have a profound impact on training. In organizations such as the IRS, training needs will escalate as new skills are required, work becomes more complex, the supply of skilled employees dwindles, and the future of worldwide electronic networks changes the basic processes of business and government. Moreover, government training programs will be needed to provide a competitive advantage in the future by attracting and retaining talented federal workers who place value on individual development and professional growth.

How can the IRS training organization position itself to prepare for the impact of the twin forces of technology and demographics? What directions should training take now to ensure delivery of high quality instruction and to contain costs? These questions formed the basis of the Training 2000 report, a research-based study that examined the external and internal environments of the IRS and the most promising technological tools and methods that would create the training system capabilities needed for the future.

A notable and fully supported conclusion of the study is that training as we know it now, primarily conducted in traditional classrooms removed from the jobsite, will change dramatically in the next decade. Classroom training is expensive and resource-intensive, and cannot be the main delivery system for a future workforce to whom training and retraining are a constant way of life. In coming years, a major portion of training will be delivered through workstations at the jobsite, using the operational systems, telecommunications links and databases that our employees will use to do their work.

In time, the distinction between work and training will become blurred, often unrecognizable to the employee. The advantages and cost-effectiveness of this new direction are compelling, and in times of increasing needs with constrained resources, too powerful to ignore. It is technology, seen as part of the problem, which also provides the solution, with its distance learning and interaction capabilities that can totally transform the way information is presented and accessed for training.

Points from the Training 2000 study, outlined below, represent:

1) research and survey data on the workplace and workforce,

2) important training technologies and methodologies for the future,

3) the ideal training system for the IRS with system requirements that are compatible with, and that rely upon, the planned information systems environment being implemented by the Information Systems Development (ISD) staff and its project teams,

4) implications for IRS that suggest directions for moving forward.

The Training 2000 study was prepared using information gathered from a wide range of sources. Published documents such as the Department of Labor's *Workforce 2000*, OPM's *Civil Service 2000*, and the Volker Commission Report provided support, along with numerous technical journals, surveys of progressive public and private institutions, and interviews with IRS functional and training managers. The extensive bibliography and number of references cited indicate the degree of rigor that was employed in this study to arrive at the final conclusions and recommendations.

KEY WORKFORCE TRENDS AND THE IMPACT ON TRAINING

- Three of four people who will be working in the year 2000 are working now.
- The workforce will be older, and there will be large increases in women, minorities and immigrants.
- Extensive training will be required to upgrade skills of current employees; a rapidly changing workplace will create needs for new skills. Retraining and job changes will be common.
- To remain competitive and productive, organizations will need to provide a broad range of training programs from basic skills training to high-level professional development.
- Large-scale automation and information systems will require massive and continuous training for end users, managers, executives, and systems administrators.
- Training will have to be very efficient, increasingly more individualized, and on demand, embedded in the system that employees use to perform their work.
- Training will need to reflect the organization, and will be characterized by an open communication system, extensive networks, immediate access, and tailored programs that can meet individual needs.

KEY PREDICTIONS FOR THE IRS WORKFORCE

(Taken from interviews with IRS Assistant Commissioners published in the Winter, 1988-1989 issue of *Leader's Digest.*)

- "One-stop concept" will be a reality. Employees will work at workstations that will provide them with immediate access to taxpayers' accounts. Employees will be able to access the latest technical reference material and internal management documents for immediate answers to technical or procedural questions.
- Flextime and flexplace will take on greater importance.
- Most employees will have their own computers linked to a central database.
- Electronic bulletin boards will contain the latest policy and procedural directions.
- Artificial Intelligence will cut through the "paper blizzard" to enable employees to be more efficient and productive, by assembling, organizing, screening, prioritizing, and retrieving thousands of records in a fraction of the time it would take a human examiner.

TECHNOLOGIES FOR TRAINING

- There are emerging and maturing technologies that hold the promise as cost-effective and powerful electronic means for meeting the massive new training needs.
- The technologies are categorized under three areas and include:

1. Computer Delivery
    a. Computer-Based Training (CBT)
    b. Artificial Intelligence (AI) and Intelligent Computer-Assisted Instruction (ICAI)
    c. Hypertext/Hypermedia
    d. Embedded Training
2. Conferencing
    a. Asynchronous Computer Conferencing (ACC)
    b. One-Way Videoteleconferencing — Live broadcast or cable network
    c. Two-Way Digital Videoteleconferencing

3. Optical Disc Technology
   a. Compact Disc, Read-only Memory (CD-ROM)
   b. Digital Video-Interactive (DVI)
   c. Compact Disc-Interactive (CD-I)
   d. Interactive Videodisc (IVD)

- Some of the technologies are delivery systems, some are storage media, some are applications. Each has specific characteristics that are important to current and future training; in addition, they are becoming interrelated in both concept and application.

- All the technologies can operate effectively and efficiently within the information system and telecommunications environment that is currently being developed for the IRS.

EDUCATIONAL THEORIES AND METHODOLOGIES

- The power of the new training technologies and their usefulness to employees and organizations can only be realized through instructional design strategies that capture the interactive and individualized capabilities of technology. Instructional design methods are essential for developing a technology-based training system.

- Older ways and forms of training cannot simply be repackaged to fit the new technology. Organizations cannot continue to "live in the rear-view mirror"; that is, use new technologies to do exactly what was done yesterday, only faster (McLuhan, 1969).

- Developments in educational theory and methods define how technology should be used to significantly enhance human skills and creativity, and to promote expert thinking and high-level strategizing for the new knowledge-based environment.

- Important instructional theories and methods include:

1. Adult Learning Principles
2. Learner Control
3. Cognitive Task Analysis
4. Expert/Novice Distinctions
5. Metacognition
6. Transfer of Training
7. Human-Computer Interface (HCI)
8. Instructional Sequence
9. Schema Theory/Mental Models

THE IDEAL TRAINING SYSTEM FOR IRS

- To meet the expanding employee skill and information needs of the future, training will have to be available, on demand, at any site, for multiple purposes and audiences. The system will require centralized planning and decentralized delivery capabilities. It will have to be cost-effective and accountable, demonstrating a measurable impact on job performance while controlling costs.

- An IRS training system with three major delivery modes can fulfill those requirements. The three modes are the classroom, field learning centers, and worksite (workstation and/or OJT).

- The major portion of training in the next decade will be delivered at the worksite, embedded in systems, through CBT, expert systems and other forms of individualized helps and tutoring sessions.

- However, there will always be times when employees will need the total training environment. Thus, classrooms and field learning centers will continue to play a key role in employee development.

- The classroom has been the dominant form of instruction within IRS. Currently, 83% of all courses are designed for classroom delivery. In the future, the amount of formal, assembled classroom training will be reduced, and chosen with care, specifically for programs such as recruit training and the introduction of major new automated systems. As a rule, it will become more efficient to bring the training to the student, by means of distance learning technology, either at workstations or at field learning centers.

- Field learning centers equipped with conference space, CBT terminals and videoteleconferencing facilities will provide a local (or nearby) automated training environment for the delivery of CBT courses, videoteleconferences, testing and evaluation. They will also provide a location for workshops, seminars, courses designed for small group interactions and coaching sessions.

- Much is already in place to build the system, in terms of training technology initiatives and experience; nationwide plans for hardware, software and telecommunications support; and system integration standards.

- The existing Automated Training System (ATS) learning centers are located at sites in all regions, districts, service centers, and large posts-of-duty. These centers are now equipped to deliver CBT courses and automation support for administration, testing, and evaluation. Videoteleconferencing downlinks can be installed through the current FTS 2000 government-wide procurement initiative. Future plans would include expansion of facilities and upgrading of hardware and software.

- The groundwork that has been laid by the ISD organization for the integrated tax administration system will provide the crucial environmental features that enable the creation and support of the proposed training system. When fully automated, the ISD tax administration system will have three tiers of computing capability:

  1. Corporate systems for multiple user populations.
  2. Departmental systems for single function populations.
  3. End user applications for front-line employees.

- Building on the concepts and categories of ISD, a corporate database of computer-based training (CBT) courses and modules could be created that would serve multiple user populations. A CBT corporate database could be accessed by any departmental system or end user, as well as by the ATS learning centers. This would provide the option of accessing either a series of modules for delivery of a formal training program in the ATS learning centers, or individual modules or lessons for use as individual refreshers or informal tutoring sessions at employee workstations.

- The connectivity capabilities of the national telecommunications backbone would link the CBT corporate database to all department systems, other end users, and ATS learning centers. The system would allow all functions the flexibility to decide how best to use training. Options would range from offering full courses at ATS learning centers to interspersing single sessions at workstations on the job.

A SCENARIO OF THE YEAR 2000

- Imagine a revenue agent in a midwestern state who has been through his basic training and is working at his job. He receives word that he has been selected for training on leveraged buy-outs (LBOs). His "class" for this course is composed of 47 revenue agents scattered around the country.

- After being notified of his selection, he receives some printed self-instructional materials on LBOs. After completing this, he reports to a nearby learning center, along with three other agents, and signs on to a CBT tutorial to examine the key elements of LBOs. His knowledge is tested via CBT. Any gaps in his knowledge are detected and remediated through careful explanation and examples.

- He then works through a series of computer-based simulations with the three other agents at the learning center. When the simulations are completed, an instructor assembles the agents for a debriefing on their work. Due to the limited availability of experts on LBOs, the instructor who is conducting the debriefing

communicates with the students in a different location via two-way video facilities. Prior to the videoconference, the instructor accessed the learners' files to examine the responses they made during the simulations and diagnosed their weaknesses.

- Once back on the job, the revenue agent calls up the simulated cases on his workstation computer to use as examples. After a few months have passed, he signs on to request the CBT course on LBOs to go through as refresher training. When working on a case, he can query an expert system to receive guidance on certain aspects of LBOs that he encounters infrequently. Finally, when he hits a problem he can't handle, he sends an electronic-mail (E-mail) note to his instructor.

IMPLICATIONS FOR IRS

- To achieve the ideal training system, the IRS must build on initiatives it has already taken and plan activities on a number of other fronts. There are two areas of implications for IRS: the development and enhancement of specific training system capabilities, and the creation or expansion of organization-wide, crossfunctional support programs.

- In the area of training system capabilities, IRS should consider moving ahead to develop embedded training in the software applications of major information systems projects as an important step toward the goal of increasing training at workstations. Maintaining the ATS Learning Centers, placing videoteleconferencing downlinks at each of these local field training sites, and pursuing plans to create a centralized, technology-based course development center are also important directions for this area. Finally, IRS must place a high priority on establishing quality guidelines for the use of new technologies and methodologies in employee training, and expand the skillbase of the training staff to exploit the power of individualized, interactive media.

- In the area of organizational implications, IRs should consider the value of broadening its current standardization efforts so that automated training systems and work systems all share a common interface. Using automation, IRS should look to a centrally-managed system of career-long tracking for employee development and a comprehensive evaluation monitoring system that will establish the links between training effectiveness and job performance. To fully implement an integrated training system such as the one proposed, IRS should consider a reassessment of training's role and level of advocacy within the organization, and most importantly, the creation of a multidisciplinary "change staff" to oversee the various initiatives that will be required.

Chapter 1 PROJECT DESCRIPTION

BACKGROUND

The approaching milestone of a new century has provided a focus for attempting to forecast the future and what it might hold. In general, the greatest interest has been on two of the forces that will impact society in the year 2000: the demographic characteristics that will determine the size and makeup of the labor pool, and the accelerating advances in technology that are affecting jobs and lifestyles in all segments of this country and the world.

One thing appears certain. The pool of highly skilled employees will be declining. Reports by the U.S. Department of Labor (Johnston, 1987) and the Office of Personnel Management (Johnston, 1988) project a future of increasing competition to attract and retain the technically-proficient employees needed to perform more complex tasks. Federal agencies especially, will feel the impact of this tightening labor market. As noted in *Civil Service 2000:*

For years, many Federal agencies have been able to hire and retain highly educated, highly skilled work forces, even though their wages, incentives, and working conditions have not been fully competitive with those offered by private employers. But as labor markets become tighter during the early 1990s, hiring qualified workers will become much more difficult (Johnston, 1988).

Even in today's labor market, Federal agencies are already facing what the National Commission on the Public Service has called a "quiet crisis" in government (Volker, 1989). In its report entitled *Rebuilding the Public Service,* the Commission cited a host of factors that have resulted in "too many of the nation's senior executives ready to leave government, and not enough of its most talented young people willing to join."

At the heart of the recruitment and retention problems is a perception that government service is no longer a source of rewarding work and personal growth. The Commission cited a lack of professional training and development opportunity as one of the key factors contributing to the loss of recruiting power.

While successful private firms spend between 3 and 5 percent of payroll dollars on professional development, the Federal government spends less than 1 percent. The Commission recommended an aggressive training program, aimed at all levels of the workforce, to ensure that talented public servants are allowed to grow and to respond to the requirements of the future Federal workplace (Volker, 1989).

At the same time, the technological advances of just the past decade are automating the workplace, and in the process, creating an information explosion that threatens to overwhelm both individuals and organizations (Weiner and Brown, 1989). In some cases, automation seems to have outstripped human capability to handle the amounts and kinds of information being produced. All indications are that this "human factors gap" will widen as the supply of skilled employees dwindles, and as the work itself becomes more difficult.

In all of the reports and analyses cited above, one underlying theme is repeated over and over again — the critical importance of training. The analysts who have foreseen the future are calling on training to blunt the twin forces of technology and demographics. In these circumstances, training is seen as the most promising option to:

- provide current employees with the new skills required for more complex tasks;
- compensate for the dwindling pool of skilled entry level workers;
- attract and retain talented young professionals through career-long development programs;
- solve many of the organizational problems created by information flow and overload;
- prepare for a future of world-wide electronic networks that will change the basic processes of business and government.

Federal training organizations do not have the resources, either financial or professional, to mount the all-out effort that would be required to meet these needs. This situation is unlikely to change significantly in a time of budget deficits.

For organizations that are caught in the crux of demographics and technology, part of the solution may lie in the technology itself. The same powerful electronic tools that are creating some of the problem may hold the key to enhancing human performance to cope with it. Technology also holds the promise as the most efficient, cost-effective means for meeting massive new training requirements (Galagan, 1989).

Mass storage and interactive technologies have the potential to change the way information is presented and accessed for learning. For the first time, instructional designers will have the long-sought tools to mirror the human thought process. The technology is, or soon will be, available. The challenge will be in overcoming old patterns and processes, and in using these technologies to their fullest to tap human capacity (Ofiesh, 1989).

As an information-based Federal agency, the Internal Revenue Service is confronting all of the current and future challenges identified above. The task facing the IRS today is to determine a course for the future. The need is for a strategic action plan that will address changes in the workplace and the workforce, the need for innovative, performance-based training programs to meet employee needs for training and professional development, and flexible, cost-effective delivery systems for these programs.

PROJECT PURPOSE

The purpose of the IRS Training 2000 project was to assess the broad developmental directions of training technology in terms of the future training needs of the IRS. The intent was to enable the agency to make intelligent decisions about staff and organizational development, as well as commitments to the hardware systems, software, and facilities that will be required. The goal was to ensure that the current IRS training organization would channel its growth into the most promising areas to ensure its capability of developing, delivering, and supporting the training required by its workforce in the year 2000 and beyond.

STEPS IN THE PROJECT

Current IRS Training. The first step involved looking at the current IRS training organization and its activities. This provided an overview of the massive scope of training, the development of nationwide delivery systems, current IRS training initiatives in CBT and TV, and the IRS work environment.

IRS Workplace and Workforce in the Year 2000. The next step was to identify possible changes in the nature of the IRS workplace in the year 2000. These changes were assessed in terms of training implications for the future IRS workforce. The changing nature of the workforce itself was then researched and documented. This information was then used to find what the combination of workplace and workforce might imply for training.

Training Technology. A key component of the project was to identify current and emerging training technologies that could be used to support the training goals of the IRS, both now and into the future. These technologies were evaluated in terms of their training implications, current applications, considerations in their use, and potential contributions to the effectiveness and efficiency of training programs.

Instructional Design Approaches. Rapid advances in training technology have been accompanied by major theories and research findings on how learning actually occurs in adults and ways in

which the new technologies can best be used for effective training. Consequently, an equally important aspect of the project was to identify specific instructional design approaches that could make good use of the interactive, individualized power of the new technologies, and that could ultimately result in vast improvements in the teaching-learning process.

Future Training at IRS. One of the objectives of the project was to explore the requirements and characteristics of a future state-of-the-art training system for the IRS. A two-day workshop was held so that IRS training and functional managers could consider some of the practical aspects and potential obstacles associated with setting up such a system.

The workshop was designed as a collaborative planning and development effort. In early sessions, participants were briefed on trends, developments and points to consider in the design of a state-of-the-art training system. Demonstrations of various new training technologies were presented, with opportunity provided to explore these directly by means of hands-on experience.

In the final session, participant groups answered specific questions that addressed various aspects of IRS training in the year 2000. Practical directions and considerations for the future, within the context of the IRS structure and organization, were proposed and discussed.

During the course of the project, information covering a wide range of training issues was gathered from a number of different sources. From an analysis of this information, a state-of-the-art training system was derived that would enable the IRS to meet its needs in the year 2000. The study also yielded several implications for IRS that suggest directions in which the agency might move to position itself effectively in the next decade.

As job requirements change, as the nature of the workforce changes, and as technology changes, the training challenge facing the IRS becomes more and more complex. This report is designed to serve as a guide to ensure that this challenge is met effectively.

Chapter 2 PRESENT IRS TRAINING

INTRODUCTION

Scope. The scope of the training task facing the IRS is reflected in the magnitude and diversity of its workforce. In 1988, IRS employees totaled 123,198, with 7,964 in the National Office and the remaining 115,234 stationed in regional, district, local post-of-duty offices and in ten service centers.

The number represents a wide range of professions, including senior level executives, lawyers, revenue agents, revenue officers, telecommunications specialists, resources management personnel, computer specialists, managers and clerical employees. IRS employees are organized into functional areas as follows:

Data Processing Operations		38,225
Collection		
19,481		
Revenue Officers	8,412	
Other	11,069	
Taxpayer Service		8,041
Specialists	1,187	
Representatives	2,570	
Other	4,284	
Examination		32,863
Revenue Agents	17,323	
Tax Auditors	3,569	
Other	11,971	
Employee Plans/ Exempt Organizations		2,753
EP/EO technicians	1,547	
Other	1,206	
Appeals		2,984
Appeals Officers	1,332	
Auditors	227	
Others	1,425	

Tax Fraud		4,634
Special Agents	3,018	
Other	1,616	
Executive Direction		140
Management Services		2,850
Resources Management		6,298
Counsel		3,059
Inspection		1,115
International		712

(Source: Internal Revenue Service Annual Report 1988 Pub. 55 (Rev. 2-89)

Challenge. The IRS must continually provide training programs to this workforce in order to meet its mission. New tax laws and new procedures require the development and implementation of new instruction. Ongoing training for career/professional development and job retraining is needed to supply IRS skill requirements.

TECHNICAL AND MANAGEMENT TRAINING

Technical Training. Training for most of the career professional fields listed above is developed by the Office of Training Program Management in the Human Resources Division of the National Office or under its auspices, and is administered by training organizations in the National Office, in 7 Regional Offices, 63 District Offices and 10 Service Centers.

Training within the career fields is divided into three categories: recruit, advanced, and Continuing Professional Education (CPE). Recruit training prepares the employees to meet the job requirements as soon as possible. Advanced training enables them to achieve increased job responsibility and areas of specialization. CPE is an on-going program that enhances the professionalism of the employees and provides coverage on topics of current interest. The topics are mandated by high level councils in each function that determine developmental needs for the professional workforce. The CPE program averages 30-40 hours each year for each function.

The majority of training is delivered through a classroom setting usually followed by a period of on-the-job training. There are some notable exceptions. Computer-based training has been developed for career fields (Revenue Officers and Revenue Agents), as well as a substantial portion of courses offered at IRS service centers. Self-instructional programs are frequently used in automation training programs and can be found in limited numbers in other career fields.

Over 600 courses have been developed to provide for the technical needs of IRS employees, varying in length from a four-hour CPE module to a multiple-phase one and one-half year program for top level examiners.

Executive and Management Training. In the Office of Research, Planning and Development of the Human Resources Division, the Management & Executive Programs Section is currently in the process of designing new integrated management development systems. The activities will incorporate selection, training, and evaluation into an integrated management system.

Entry Level. The new program for entry level supervisors and managers is called Leadership Excellence and Development (LEAD). It is transitional in nature and has three components: an Administrative Skills Kit (ASK) that is heavily weighted towards personnel issues such as employee evaluations and labor relations; a core component that deals with communications and relationships with upper management, peers, and subordinates; and a functional component that addresses areas in that particular function, for example, interpreting the Audit Information Management System (AIMS) tables.

Mid-Level. The Management Development Program (MDP) II training covers such topics as stress awareness, management style and cross-functional subjects. The course is attended by managers who have subordinate managers. Plans are underway to redesign the mid-level program following the program for entry level managers as a model.

Division Chiefs. Training for upper level management is in a transitional stage. A design team has been selected composed of Division Chiefs, a contract facilitator, and a District Director, along with staff in the Management and Executive Program Section. The team is using the outputs and competencies outlined in the Executive/ Management Performance Model, which has been developed as a guide to identifying training needs.

Continuing Management Education (CME). CME provides for the ongoing professional needs of IRS managers. Professional seminars, courses developed within the Service, or enrollment at an educational institution are some of the ways these needs are met.

An IRS quarterly magazine for managers, the *Leader's Digest*, contains valuable insights and information for their ongoing professional development.

Executive Development. The six-month Executive Development program administered by the Office of Executive Support provides the newly selected executive with a broad range of experience. Visits to regional and district offices, visits to Service Centers,

classroom training with presentations from executives in the functional areas, a variety of guest speakers from industry and government, and other developmental activities, as appropriate, comprise the program. The purpose of the program is to help the executive develop the "big picture." At the end of the six month period, the executive is assigned to a position that will provide additional experience.

TECHNOLOGY IN TRAINING

There have been several initiatives in the IRS to use technology in training. For many years, high-quality videotapes and audio-visual materials have been successfully produced in support of training programs. Currently a major effort to implement a nationwide computer-based training system is nearing completion. The Computer Services function has six interactive videodisc stations at the National Office, and currently offers 12 programs for employee training. There are also pilot projects in interactive videodisc technology in the Austin Service Center, Boston District, Andover Service Center, and National Office Resources Management. Many sites have purchased commercial courseware to teach individual employees how to use existing hardware and software.

Video. The Product Development Support Section of the Office of Training Program Management (OTPM), in coordination with other organizations, provides video design, development, and production support for audiovisual materials. The Service has a studio in Crystal City, Arlington, VA, that is used for media training, training video production, and communications videotapes.

This section is currently investigating developments in teleconferencing and its possible use in training, having already completed several videoteleconferences for IRS management and nationwide communications.

Automated Training System (ATS). ATS is presently the primary delivery vehicle for computer based training (CBT). Approximately 1000 terminals are connected to CPUs in 109 sites throughout the country. By October 1989, there will be 1300 terminals in 169 sites nationwide. Ten Service Centers throughout the country have numerous programs on the system. As mentioned previously, courses in the Revenue Agent and Revenue Officer programs are on ATS, and courses for other functions are currently under development.

To date, the majority of courseware has been developed for Service Centers. Currently, efforts are underway to increase the quantity of courses available for district and regional use.

TRAINING DEVELOPMENT

Technical training for the major career fields, such as Examination, Collection, and Taxpayer Service, is developed at the National Office or in the field under the guidance of OTPM. Criminal Investigation training, however, is developed in Glynco, Georgia. Training material is also developed locally where the training is needed.

Training Development Quality Assurance System (TDQAS). IRS course development follows a series of standardized procedures that are based on widely accepted principles of instructional technology and the systems approach to training. The TDQAS uses a six-phase process that includes Assessment, Analysis, Design, Development, Implementation, and Evaluation. The TDQAS is a tool that enables training developers, their managers, and their clients to plan and to build, step by step, the level of quality desired in course development projects. TDQAS is published in three different volumes addressed to specific audiences: Training Client Version, Training Manager Version, and Training Developer Version. All three versions outline the phases and actions that constitute an approach to the entire training development process.

Course Development Staff. The Office of Training Program Management is staffed with three categories of training and development professionals who are responsible for all training development. In addition to these Employee Development Specialists, Education Specialists, and Course Developer/Instructors, the IRS uses task forces of subject matter experts from the field to assist in the development of course material.

The number of task force participants and the length of their stay varies with the complexity of the module to be developed. The use of task forces working in the National Office or in the field, with guidance provided by the Education Specialist or Employee Development Specialist, has proved to be a very successful way to meet the challenge of developing or updating and revising the 600 training courses that are currently available.

Delivery. On the whole, training is delivered via classroom instruction, alternating with periods of on-the-job training. CBT and other self-instructional technologies are also used, as noted above.

COORDINATING IRS TECHNOLOGY EFFORTS

A newly-created Assistant Commissioner for Information Systems Development (ISD) has responsibility to oversee the redesign of the tax processing system and to provide coordination to all information system projects. When the redesign is complete, it will consist of corporate databases containing common information needed for tax administration; departmental systems (Automated Examination Sys-

tem, Integrated Collection System, Automated Taxpayer Service System) containing data specific to the function; and automation support for specific local office needs.

A number of automated information system projects are being developed and implemented. ISD will work with the other functions as a managing partner for effective integration and standardization of the various information systems, some of which are listed below.

Automated Examination System (AES) is a servicewide, automation project for the Examination function. Implementation started in 1985 with the distribution of over 15,000 portable computers to revenue agents. Training has continued as new agents enter the Service and new applications are developed and revised and updated with the new tax law. Later phases will include tax auditors and managers equipped with UNIX-based desktop and laptop microcomputers supported by office environment minicomputers. The minicomputers will support the microcomputer system through the Treasury's Consolidated Data Network (CDN). Approximately 29,000 users in over 700 locations will have access through CDN.

The training requirements for the AES program reflect the challenges of all new automation initiatives: how to train large numbers of nation-wide employees of mixed age, experience and motivation, at minimal cost with the highest level of quality.

Another servicewide system is the Integrated Collection System, or ICS. This project will have 21 mainframes and 20,000 laptops when complete. The system will eventually bring all collection automation efforts into one integrated system. The latest date for full scale implementation of this project is 1991.

Still other automated information projects in progress include:

1) The Automated Taxpayer Service System (ATSS), which uses personal computers as terminals to permit the taxpayer service representative to research technical databases, provide refund status information, and consult expert systems to answer taxpayer questions.

2) The Automated Criminal Investigation System (ACI), which provides automated analytical tools for case and management analysis and allows the sharing of data throughout the nation.

3) The many automated information systems that are housed in the 10 Service Centers nationwide.

OTHER INITIATIVES IN THE IRS

Course Development Center Proposal. The IRS Human Resources Division (HRD) has proposed establishing a centralized Course Development Center in the Washington, D.C. area. At present, OTPM is located in several separate facilities, adversely affecting quality course development. The proposed center would house all of the OTPM training sections, except the TV studio. Also, the center is envisioned to provide:

- classrooms
- meeting space for task forces
- video preview room
- computer/terminal areas
- library with on-line search service
- usability lab
- support services

Telecommunications Capability. The IRS is installing data transfer capabilities using the PACNET system that has recently been renamed the Consolidated Data Network (CDN). CDN is a nationwide network of dedicated high-speed lines that connect the IRS regions, districts, service centers and posts-of-duty permitting fast, error-free data transmission to all IRS internal networks and databases. CDN uses packet switching technology, which will be further augmented by the dedicated circuitry being planned for the ISD national telecommunications backbone. In addition to Treasury/IRS systems, a government-wide procurement initiative entitled FTS 2000 is beginning to be implemented throughout the entire federal organization. FTS 2000 is a private, dedicated telecommunications network which will use digital transmission and state-of-the-art fiber optic cables. The current assumption is that by the Year 2000, a single line will be able to carry video, voice, text, and data from one computer to another, anywhere in the world. However, only the switched voice services, which provide for ordinary long distance phone calls over telephone lines, will be installed automatically. Each federal agency will select the additional services needed.

Artificial Intelligence Lab. The IRS is currently exploring potential projects that would use the capabilities of artificial intelligence. There are now 13 projects undergoing development in the AI Lab, and many small expert systems are being created under their direction. Among these are expert systems being developed by OTPM staff to aid decision-making in course development projects. Job-related projects such as the International Section 482 Expert System, which replicates the reasoning process of expert international examination agents, may provide insight, as well as an instructional tool, for the training of such agents.

National Automation Coaching and Training Center (NACTC). This program is an example of a distance learning system developed for specialized needs. The NACTC in the Austin Service Center was established to provide automation training for UNIX-based systems for data processing personnel located anywhere in the nation. The fulltime coaching staff in Austin works with the new employee and his or her manager to develop a curriculum that is a carefully blended mix of self-instructional modules, assistance and support from an assigned coach at the center, follow-on classroom instruction and evaluation.

The coach assigns modules to the employee who works at his or her workstation, following a schedule that has been arranged with the manager. The coach is available by phone to answer student questions, and the coach monitors student work on the terminal. After the modules have been successfully completed, the coach and manager schedule the employee for the wrap-up classroom training. This approach enables the function to provide customized training material to the employee at the workstation on an as-needed basis, and helps prepare the employee for new job responsibilities without leaving the current job or incurring high travel and per diem costs.

SUMMARY

Training in the IRS today faces: 1) a large, diverse, and geographically dispersed workforce, 2) an environment of rapidly changing tax laws and procedures, and 3) a proliferation of new automated processes and information systems.

The current approach is to develop three separate training activities for professional, management, and executive training. Professional training is separated by functional area, and includes recruit, advanced, and CPE in each specialty. Other training or training-related activities are underway throughout the organization, especially in the 10 Service Centers. Most of these initiatives are related to data processing and information systems.

At this time, the primary delivery method for IRS training is classroom instruction, often combined with on-the-job training. However, the Automated Training System for CBT, and initial efforts in interactive videodisc-based courses, are in place, together with a video studio for videotape production. Videoconferencing is also being investigated for delivery of training programs.

The next chapter looks at the trends that will impact IRS training needs by the year 2000, including changes in the workplace, workforce, distribution systems, educational theory, and management issues.

Chapter 3 FACTORS IMPACTING IRS TRAINING: *PART 1. THE CHANGING WORKPLACE AND WORKFORCE*

INTRODUCTION

To fully appreciate the training challenges faced by the IRS in the future and the complex decisions that will be made to meet these challenges, it is important to understand the context within which the Service is operating. This chapter discusses factors that impact the directions in which the IRS will move in coming years.

The chapter begins with an overview of the future operations of the IRS' major functional departments, as seen from the perspective of the functional Assistant Commissioners. This information is condensed from the Winter 1988-89 edition of *Leader's Digest*, the IRS quarterly publication for managers, in which the Assistant Commissioners shared their views on how their operations and people might be doing business in the year 2000. The focus is on the changes that will need to be made in each functional area to keep pace with rapidly changing job requirements and advances in technology.

The chapter ends with a discussion of trends in the U.S. workforce. These trends involve changes in workforce size and characteristics, in geographic movements, and in the skill levels that workers will bring to the job by the year 2000. These workforce characteristics will determine the types of training that will be required to meet changing operational needs.

THE IRS WORKPLACE IN THE YEAR 2000

IRS training in the 21st century will need to support the functional work of the organization. One of the critical factors in planning is trying to envision the workplace of the future. What processes will have changed? What operational systems will be in place? How will the primary work of the IRS be conducted?

In the Winter, 1988-89 issue of *Leaders Digest*, the Assistant Commissioners for each IRS functional area described their views of the future for their organizational units. Summaries of these future visions are presented below as indicators of what the IRS future workplace may be. The summaries are followed by a discussion of the training implications associated with the predicted changes.

Predictions from Information Systems Development

Since the primary business of the IRS is information processing, the year 2000 will bring significant changes in the way information is obtained, stored, retrieved and managed. The IRS expects a 22% increase in the number of returns filed, yet advances in technology will enable efficient handling of this increase.

Some of these anticipated technological advances, and their effects, are listed below.

- Electronic Filing will automate the process of filing and processing tax returns. This will reduce the costs of collecting tax information, lower the volume of paper documents and decrease waiting periods for refunds. When fully implemented, the system will process up to 30% of all returns; error rates will drop to 3% from the current 20% for processing paper returns.

- Optical scanners will simplify the input of paper-based returns, resulting in more data available to the IRS, and at lower cost.

- The redesign and automation of handling systems will permit direct posting to the taxpayer database by the returns processing system. This will speed refunds, reduce error rates, and eliminate lost or misrouted correspondence.

- A structure of linked databases will provide IRS staff with quick access to a taxpayer's entire account. This will permit retrieval of data from previous returns and tax years.

- The redesigned system will ensure availability of required data to IRS staff to provide a single point-of-contact for problem resolutions. This will reduce delays and repeated requests.

- The Service Center Support System (SCSS) will automate many current manual functions, streamline input processing, and reduce reliance on paper. The system will include an on-line inventory control and management information system and the Automated Underreporter Program (AUR).

- The Image Scanning System or Digital Image/Optical Data Storage System (DI/ODSS) will use scanners to image paper into digital format, and high resolution video display terminals, permitting rapid retrieval of documents and eliminating delays.

- The On-Line Entity Index will automate recordkeeping of taxpayers' names, addresses, and identification numbers, resulting in faster correction of problems, quicker response to inquiries, proper routing of notices and correspondence, and improved customer service.

Predictions from Taxpayer Service and Returns Processing

By the year 2000, this functional area will have fully implemented the "one-step concept" of service to taxpayers. The assistor who has first contact with the customer will be able to take all necessary actions to render assistance and solve problems. This will be possible by incorporating computer technology to provide every Taxpayer Service Specialist and Taxpayer Service Representative (TSS/TSR) with ready access to all information required for decision-making. Each TSS/TSR will work at an efficient workstation, equipped with desktop computer and videophone. Advanced skills training will be implemented to ensure efficient use of the system.

By 2000, the TSS/TSR will be able to:

- access an account and make corrections or adjustments while the taxpayer is present or on the phone;
- immediately verify taxpayer information;
- access the latest technical reference data, expert systems, and internal management documents for technical and procedural information;
- generate management reports automatically;
- interface electronically with the IRS forms distribution center to generate forms mail-out to taxpayers;
- and provide personal contact to customers via videophone.

Because technology will speed service to taxpayers, the handling of account problems will not dominate the workload of the TSS/TSR. Rather, the primary duties of these employees will involve educating the public on technical and procedural issues. It should be noted that customers in the year 2000 will be more knowledgeable about tax law than they are now; this will require a higher degree of technical knowledge and expertise by the TSS/TSR in order to meet the complex needs of the public in the future.

Predictions from Examination

In preparing for the future, the Examination functional area is concentrating on organizational and personnel issues. Internal emphasis is being placed on effective recruiting, training, developing, supporting and rewarding of employees to ensure their successful performance in the 1990's and beyond. An additional focus is on developing effective compliance strategies, customer relations approaches, and enforcement programs.

This functional area will also become highly automated, and will involve electronic data transmission, the use of artificial intelligence systems, and the examination of tax returns software systems.

Examiners will be able to access all IRS databases to obtain tax information needed for audits. They will also be able to access their mail from audit sites and communicate with other examiners electronically, as well as consult electronic bulletin boards for the latest policy and procedural directives and download taxpayers' records to IRS computers.

When audit cases are completed, examiners can make final revisions, close the cases, and forward them for assessment electronically. The artificial intelligence system will also be used to check cases for compliance according to IRS auditing standards.

Other aspects of the Examination organization of the future include:

- examination of systems rather than just tax returns; for example, tax return preparation software used by practitioners;
- use of automated referral systems for recruitment of new personnel nationwide;
- flexible work schedules, made possible by computer links to a central database;
- automated, self-paced training available at employees' duty posts; also more training for target positions and specialty occupations;
- enhancement of internal communications.

Predictions from Employee Plans/Exempt Organizations

The Employee Plans/Exempt Organizations (EP/EO) function is responsible for determining the merit of applications from employee retirement plans and from organizations seeking exemption from Federal income tax. This group also coordinates field examinations of those organizations under its authority. Due to changes in tax law, Congressional hearings and several well-publicized tax abuse cases involving exempt organizations, public attention has focused on this function in recent years.

As computerization of this functional area becomes fully implemented, improvements are anticipated in the following operations:

- accessing the Service records of exempt organizations or plans;
- issuing EP/EO reports and memorandums;
- handling returns;
- conducting examinations;
- communicating and distributing information internally by means of electronic mail.

Computerization will involve equipping each EP/EO employee with a computer terminal that is linked with others within the functional area and with the service and data centers. The new system will provide immediate access to Service records and end the need for microfiche or paper records and transcripts. The electronic filing of returns will result in more efficient processing and posting of returns.

These technical advances may permit other innovations within this functional area. EP/EO employees may be able to work at sites other than the usual office environment, such as at home or in the field. Revenue agents will be able to use the expanded information resources to increase their field capabilities such that they can make an adjustment to a taxpayer's account directly, upon completion of an examination.

Managers, too, will change in the way they direct their operations. By the year 2000, they will rely more on data from computer files. They will need to integrate new employees who already have computer skills with older employees who may have limited skills in this area and little motivation to learn them. To meet the needs of the year 2000, managers must provide sufficient training to ensure that all employees can function effectively with new technology.

An important objective of the EP/EO functional operation is to become sophisticated and proficient in using advanced technology in order to provide efficient, high-quality services to its customers. Training efforts will be geared toward this goal.

Predictions from Collection

Primary Collection activities include investigation, research and enforcement, with the mission of the group focused on quality service. While this mission will not change in the years to come, the ways in which activities are conducted and the mission is achieved will change significantly.

The widespread introduction of computers has permitted more effective use of the information resources required by revenue officers and collection employees. Increasingly, these employees will be able to access real estate tax rolls, banks, motor vehicle departments, trade organizations and all internal IRS service records quickly and efficiently.

The implementation of the Automated Collection System (ACS) in 1984 eliminated dependence on paper-based operations by incorporating advances in telecommunications and computer technology. The result was a significant improvement in the ability of the Collection group to resolve cases satisfactorily in a timely manner.

Since 1984, Collection has focused on automating its field operations. The new Integrated Collection System (ICS), as it is now conceived, will house a large database that will integrate information from several sources. From automated workstations equipped with portable computers linked to a mainframe computer, revenue officers will be able to access data, records and software programs to perform a wide variety of Collection operations.

ICS will eliminate the duplication of information, automatically generate required forms, alert revenue officers to statute expirations, and perform many calculations involved in collection activities. The system will result in better case management by revenue officers, more efficient time management by both officers and managers, and faster adjustment of resources as necessary.

For taxpayers, the ICS will speed account adjustments, improve customer service, and ensure only those enforcement actions that are really necessary.

Predictions from Criminal Investigation

At present, the Criminal Investigation area consists of a number of independent systems around the country. With the implementation of the Automated Criminal Investigation System (ACI), these separate entities will be completely integrated into a single computer system that will unify all of its multiple hardware and software process components.

This integration will permit the incorporation of special software programs developed by individual agents. It will also result in a significantly greater computer capability that will be more accessible to all.

One aspect of the ACI system that differentiates it from other computer systems is its Artificial Intelligence component. This AI capacity, which will be in operation even before the year 2000, will make it possible for agents to systematically examine thousands of records in a fraction of the time it would take a human examiner. This significant change will result in a greater proportion of agents' time spent in judging and analyzing rather than in time-consuming searching of records.

The AI component of ACI will operate in three phases. In Phase I, the program will scan all relevant data for the given problem or application. In Phase II, the program will review the data and accept, reject, or "clean" it as appropriate. In Phase III, the program will analyze the data by applying specified rules developed to determine possible improprieties. At this point, the special agent will determine whether or not to pursue specific matters further.

Because the ACI system will be linked to other IRS systems, agents will have immediate computer access to a huge volume of data to support their activities. In addition, the time-consuming tasks of assembling and organizing information and evidence, as well as report generation, will be speeded up significantly by the AI component of ACI, leaving more time for evaluation, strategizing and case preparation.

Additional time-saving capabilities that will be made possible by the ACI system include submitting time sheets, vouchers and leave requests electronically; reading reports remotely; inputting new evidence; reviewing old evidence; sending memorandums; and linking up with the central office from the field. A secure Criminal Investigation Radio Communication Network will permit the retrieval of exact images of documents from remote field sites.

The Criminal Investigation functional area will operate more efficiently as a result of the ACI technology. More and better evidence will be gathered so that difficult cases will be more likely to reach the trial stage, and evasion will become more difficult. In addition, it is expected that taxpayers will develop greater confidence in the ability of the IRS to investigate and prosecute those who have violated the law.

Predictions from International

As the U.S. economy continues to expand globally at a rapid rate, the challenges facing International are also growing. In order to provide service and promote compliance worldwide, such factors as mail delivery, communications, security, language and time differences, that are manageable in the domestic environment, often become complex and sensitive problems when applied across borders and time zones.

The International organization focuses on U.S. tax law as it affects international trade, exports and imports, and U.S. foreign investment. In recent years, advances in telecommunications have enabled the IRS to link these areas of endeavor together effectively and to improve communications among all of its offices throughout the world. This technology will continue to be the dominant one for International in the years to come.

One new initiative is a worldwide, toll-free, 24-hour telephone assistance network that will provide tax and account information service to any customer, anywhere. This operation, staffed by multilingual employees specially trained on foreign issues, will be able to shift between taxpayer assistance and collection activities, depending on workload demands.

International will also be able to provide services equal to those available within the U.S. For example, the shipboard population served by the APO/FPO (Atlantic Post Office/Fleet Post Office) will have access to centralized filing, electronic filing, and electronic funds transfer. Centralized computer processing sites will link these remote sites with the Philadelphia Service Center.

Advances in telecommunications technology, coupled with decreases in costs, will permit Revenue Service Representatives stationed throughout the world to communicate by voice, data, and facsimile as easily as U.S. based agents do now. In addition, electronic filing will permit the sending of memos, files, reports, and inquiries anywhere in the world, thereby improving both internal and external communications and services. It is anticipated that, via satellite communications and speech recognition and synthesis, taxpayers will be able to have their telephone inquiries answered by a computer, which will then link them to the appropriate video explanations, displayed on their television or home computer screen.

Another prediction for the year 2000 that will be possible as a result of advances in telecommunications involves the area of tax administration in tenns of international banking. As electronic funds transfer technology becomes more sophisticated, market boundaries will become transparent. This means that international trading markets will be created, such that complete intercountry fund transfers can be performed in real time. While this capability, with accompanying tax issues, is already being utilized by multinational corporations, it will soon be available to individuals as well.

Training Implications

The Assistant Commissioners, through their interviews in the *Leaders Digest* article, have predicted a future that is a continuation of the present — large-scale, Service-wide automation of systems and the increased use of telecommunications technology. They have also described a workplace where all of these systems, and the employees who are using them, are operating efficiently and effectively. A great deal of preparation and training will have to occur if the future as predicted is to become reality.

The changes described touch every segment of the workplace. While each change is predicted to increase work efficiency, the new technologies themselves will have to be mastered if they are to become useful tools. Each of the automated systems described above will involve system-specific procedures and skills. Phrases like "optical scanning," "database access," and "electronic communication" have to be translated into human processes and learned by adult professionals, many of whom currently are totally unfamiliar with computer-based processes.

Many changes will need to be made to equip employees with the required skills that will enable them to operate effectively within this computer-based, electronic workplace.

Training and retraining initiatives for all functional areas will focus on several broad, general skills areas. These include computer skills, communications skills (both internal and external), and technical skills. In addition, each functional work group will need an emphasis on particular aspects of these skill areas in order to meet unique job requirements.

Computer Skills. Because all internal IRS documents, taxpayer account information, records, research databases, and reporting functions will be on computer, most IRS employees will need to have basic computer skills that cover data entry, storage and retrieval, database management, and electronic filing functions. Additional skills may include using artificial intelligence programs, electronic funds transfer, and the ability to utilize computer linkages with video technologies.

Each functional area, however, will develop its own unique combination of required skills. For example, Taxpayer Service Specialists and Representatives (TSS/TSRs), from the Taxpayer Service and Returns Processing area, and special agents from Criminal Investigation may need proficiency in data entry, research and investigative skills, while Examination and Collection employees may need skills in database management. In the area of artificial intelligence, it is already anticipated that examiners will need to know how to use new artificial intelligence programs for auditing purposes; and special agents will need advanced training on the use of the artificial intelligence component of the ACI system.

Communications. Communications skills will be increasingly important to IRS employees in all of the functional areas. The redesign and automation of internal systems, and advances in telecommunications technology and satellite transmission will require a more sophisticated communications network than is currently operating. Both internal and external systems will need to be developed and set in place, and training programs will need to be produced to familiarize employees with the new technology and its uses.

The focus in some of the functional areas will be on internal communications, to the extent that job requirements call for good planning skills, effective coordination and time management techniques, and efficient supervision and management skills.

In those other areas with important customer service and public relations roles, there will be a greater emphasis on external communications. In the future, these roles and services will be even more visible and important than they are today. Customers will be more knowledgeable and will expect high levels of skilled, efficient

service. Taxpayer Service, Examination, Employee Plans and Exempt Organizations, and Collection are some of the functional areas in which training in interpersonal communications skills will be needed. The International functional area will have additional communications training needs in foreign languages, international banking and law, and computer/video linkages, among others.

Technical Training. Each functional area will have specific technical training requirements geared to the particular nature of the work performed by employees in various job categories. Courses will need to be designed, developed and produced that not only cover the necessary technical skills, but also incorporate these with computer technology.

For example, in the Taxpayer Service area, technical training might cover researching the tax code, regulations, commercial tax services, court cases and internal management documents. This work group also has need for skills training in teaching and delivery, as the TSS/TSR will function to a great extent as an educator by the year 2000.

The Examination group will need technical training in auditing, finance, and tax law. While most Examination employees will certainly need training in these subjects, some groups and individuals will be specially selected and trained for various target positions and specialty occupations in examination or management.

Technical training will also be needed in the use of new telecommunications technology, video linkages, electronic filing and funds transfer, and training delivery systems. Other topic areas may include business writing, recordkeeping, report writing and generation, investigative and evaluation techniques, economics, and international finance and banking.

WORKFORCE DIRECTIONS

The previous section provided a view of the IRS workplace in the year 2000. The next issue is the workforce. Who will fill the IRS workplace in the year 2000?

Labor pool and workforce characteristics are expected to change over the next 11 years. The data presented in this section indicate that:

- the workforce will grow at a much slower rate than during the past 14 years;
- fewer young, highly-qualified new employees will be entering the labor pool;

- composition of the workforce will change, with older workers, women, and ethnic minorities in larger percentages; and

- geographic relocation of the labor pool will continue.

These changes will affect how all organizations recruit, train, and retain qualified employees. They will especially influence government agencies that are less competitive than private industry in hiring and retaining qualified workers.

This section presents the details of these changes, together with some implications for training. It draws heavily on recent landmark publications, including *Workforce 2000*, a U.S. Dept. of Labor report published by the Hudson Institute (Johnston, 1987), and *Civil Service 2000*, a U.S. Office of Personnel Management report published by the Hudson Institute (Johnston, 1988).

Workforce Size. According to Bureau of Labor Statistics estimates (Fountain, 1987), the workforce will grow from 118 million to 139 million between now and the year 2000. This is an annual growth rate of only 1.2 percent, lower than at any time in history other than the Great Depression. At the same time, the labor pool of young entry-level workers will be declining from 20 to 16 percent of the population. Even in a slow-growth period, this dwindling supply of talent is going to create an extremely competitive marketplace, a situation that will place the Federal sector at an increasing disadvantage (Johnston, 1988).

Figures from *Civil Service 2000* (Johnston, 1988) show approximately 2.29 million Federal employees in 1987. The Treasury Department accounted for 149.2 thousand, or 6.5 percent of the Federal workforce in 1987. Within Treasury, the IRS employed approximately 123,000 people.

The Federal workforce is expected to stay at approximately the same size in the coming decade. However, some agencies, including the Treasury Department, are expected to grow. Automated processes, changing tax laws, and growing financial complexity and litigiousness in the society also point to some growth in the IRS workforce (Johnston, 1988).

With the decreasing pool of entry level workers and the relatively slow growth of the workforce, organizations cannot look to a large infusion of highly-skilled new hires to fill the more demanding jobs created by increasing automation. In fact, three out of the four people who will comprise the workforce in the year 2000 are already working (Johnston, 1988).

The first training implication, of course, is that current employees must acquire or hone the skills necessary to become the "knowledge workers" of the present and the future. The second training

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implication is that the IRS and other Federal agencies will need to provide professional development opportunities as a tool to compete with the private sector for scarce talent (Volker, 1989).

Because fewer new employees will be entering the workforce, organizations also will need to attract and retain older workers. Current trends toward early retirement will tend to disappear. Employers may find it necessary to develop incentives, including training and development programs, both to retain and attract workers past today's normal retirement ages (Ehrlich and Garland, 1988).

Workforce Age. The next 11 years will be a time of gradual aging of the workforce. The number of workers 16 to 24 years old will decline from 20 to 16 percent of the population, while the percentage of people over 55 will also be declining, according to Bureau of Labor Statistics (Fountain, 1987). The U.S. Dept. of Labor's report, *Workforce 2000*, projects a glut of workers between 35 and 54 years of age. Workers between 35 and 47 will increase by 38 percent, and 48 to 54-year-old workers will increase by 67 percent between now and 2000 (Johnston, 1987).

The current Federal work force is already older than the national average. Today, the national worker median age is 36, while the median age for Federal workers is 41. If this trend continues, by the year 2000 when the national median age for all workers will be 39, median age for Federal workers will be 44.

The workplace changes brought about by technology will have an inordinate effect on the large group of workers between the ages of 35 and 54. Many jobs that this group is performing now will likely disappear or be redesigned. Most jobs that will arise will require higher skill levels than are presently necessary. These workers also may be more resistant to learning to use new technologies (Newell, 1989).

Automation will also bring about other changes that will influence the career paths of these employees. Information systems are already replacing the need for levels of management in industry. This trend is expected to continue. By 2000, it is estimated that there may be as many as 50 applicants for every managerial position, compared to the 20 to 1 ratio in 1987 (Cetron, Rocha, and Luckins, 1988). Many workers in the 35 to 54 year age bracket who anticipated achieving managerial goals will be disappointed by the lack of opportunity for advancement. One task facing both government and industry is to create alternative career tracks of lateral moves and challenging assignments to replace lost vertical movement.

Workforce Preparation. A major concern facing a future employer will be a widening gap between employee ability level and the skill level needed for the job. Technology-oriented tasks demand a higher skill level, yet employees are receiving less education. In 1985, the median number of school years completed by individuals 25 and older was 12.6 years (Bruno, 1987), compared to the 12.8 median number of years of education required by the workforce (Johnston, 1987). This disparity is expected to increase.

Today's corporations are already spending between $40 billion (Galagan, 1989) and $80 billion (Cetron, Rocha, and Luckins, 1988) annually on employee education and training. Some of this training is directed at basic skills in reading, spelling and math, in addition to professional training and development. The amount spent in industry is predicted to double by the year 2000. One forecast is that 25 million current workers will have to be upgraded by 40 percent in the next decade (Packer, 1988). The inclusion of new workers raises the number of employees needing training to approximately 50 million (Bernstein, 1988).

Skill levels in the Federal workforce will become even more important as blue-collar jobs disappear and white-collar jobs expand. As noted in *Civil Service 2000* (1988), clerical positions in the Federal government declined from 22 to 19 percent between 1976 and 1986, while blue-collar jobs decreased from 24 to 19 percent. The number of technical, professional, and administrative jobs rose from 52 to 59 percent during the same period. Further, over 16 percent of current Federal jobs require employees to have "above average" skills in reading and writing. That is, they must be able to read technical journals, financial reports, or legal documents, and write journals, manuals or critiques. These kinds of positions are expected to grow between now and 2000 (Johnston, 1988).

Each of these demands has potential IRS training implications. The IRS must compete for large numbers of employees in many local labor markets where higher education is not the norm. As labor markets tighten even more, there will be more applicants without basic skills in reading and math. In addition, many IRS job categories require the types of reading and writing skills described as "above average," and, thus, will require more training than less demanding jobs.

One of the challenges facing IRS training is that employee skill requirements cover such a broad range of expertise and educational levels. Much of the operational work of the Service requires high levels of education in professional fields such as accounting, law, computer science, finance, and business administration.

According to *Civil service 2000* figures (Johnston, 1988), the Federal workforce is currently better educated than the national average. Today, 31 percent of Federal workers have four or more years of

college, while 23 percent of national workers have the same level of education. However, Federal agencies, including the IRS, are already in stiff competition with the private sector for employees with college degrees. For example, on an average, the "Big Eight" accounting firms hire from the 86th percentile of the national CPA examination, while the IRS hires those from the 54th percentile. With decreasing numbers of entry-level professionals, this trend is likely to continue.

The challenge to training is twofold. First, recruit training in some professional fields may need to be more basic and rigorous to ensure that new employees have the skills they need for their first field assignments. Second, the long-term goal should be to attract higher ranking graduates through the kinds of professional development programs and career opportunities that they are seeking (Volker, 1989).

Workforce Location. The *Civil Service 2000* Report (Johnston, 1988) provides data on two primary relocation movements that will have an effect on the future workforce and training. The first is relocation between regions in the United States. People will continue to migrate to the Sun Belt, though the pace is expected to slow for the remainder of the century. At the same time, population increases from 50 to 150 percent are predicted in the Rocky Mountain States during the 1990's.

The people moving into these areas will be coming primarily from the upper Midwest Region and the North Central Region. For the North Central Region, projections show a 22 percent drop in people 22 to 34 years of age, while the West will have an eight percent increase in that age group. Increases in both coastal areas will include the relatively large influx of people who are expected to immigrate into the country in the next decade.

These population shifts have implications for IRS labor markets in different regions. The migration of 22 to 34 year-olds to the West Coast may improve IRS opportunity to hire the coveted younger worker in that area. The loss of population in the North Central Region will likely create an extremely competitive local labor market. One implication may be that training in that Region will need to be geared toward older workers and women entering the workforce for the first time.

IRS offices in metropolitan areas may find both a populace and a labor market with increasing percentages of foreign-born citizens. There are two interrelated training implications in these situations. Training may need to include more basic preparation, including brush-up courses in English as a second language and in business practices. Also, language training on cultural differences will be needed for IRS employees who will be communicating with taxpayers and answering citizen requests for information.

According to *Civil Service 2000*, the second, and maybe more significant, population shift will be from the cities to "exurbia," developments located 25 to 100 miles outside existing urban centers (Johnston, 1988). As more people move farther away from their work sites in the cities, "telecommuting" will become more common, with both work and training taking place off-site, connected by electronics. This trend will be a major factor in the move toward distributed, individual training. It will also create a number of changes in the workplace in terms of traditional reporting activities, management responsibilities, and work relationships. One training implication for the IRS is that management training will need to prepare supervisors for these changes with new management skills.

As shown above, the important point in planning for the impacts of changing geographic patterns in the workforce is that they will vary by IRS Region. Flexible training programs that can be tailored to regional needs will be an important consideration.

Workforce Composition. The U.S. labor force will change significantly in the coming decade. Native white males are projected to comprise 16 percent of entering workers in the year 2000. Native white females will be the largest category, at 43 percent. Native non-white females will also outnumber native non-white males. There will be a slightly higher percentage of immigrant males than females (Johnston, 1987).

The *Workforce 2000* report also projects that 61 percent of the entry workers between now and the year 2000 will be female (Johnston, 1987). As a result of this trend, the percentage of females in the workforce will have risen to 47 percent by 2000. A related projection from the Bureau of Labor Statistics is that the number of two-earner couples will grow from 49 percent to 57 percent between 1985 and 2000 (Fountain, 1987).

As noted in the section on workforce age, most of these women will be in their late 20's to early 40's, the years of child-rearing. Currently, one half the women in the workforce have children under six years of age. The number in this category is expected to rise to two thirds by the mid 1990's (Johnston, 1987).

This increasing percentage of women and single parents in the workforce has significant implications for a number of issues including pay equity, child care, flexible working schedules, "telecommuting," and the need for flexible training delivery, including individual and self-paced training. "Flextime" is already a fairly common practice in both government and industry. Advances in electronic telecommunication are behind the growing movement to "flexplace," with more employees working at home part- or full-time. Individual, self-paced training also is gaining in popularity. These trends will increase as employers seek to accommodate the badly-needed women workers who also have family responsibilities.

Another factor is that many middle-aged women will be entering the workforce for the first time, or will be moving up from low-skilled positions. Preparing these large numbers of new or reassigned workers is going to be one of the largest training challenges for the future (Johnston, 1988).

The growing percentage of minority workers also will have an impact. Included in this category are Blacks, Hispanics, and Asians, both male and female, native and foreign born. Of the 21 million jobs that will be created between 1986 and the year 2000, 57 percent are expected to be filled by minorities. Further, minorities will account for 29 percent of the net additions to the workforce between 1985 and 2000 (Johnston, 1987). These workers will present a broad range of training needs. As noted in the section on workforce size, foreign-born employees may need basic help in writing and speaking English, and in U.S. business practices. Native-born minority employees may also have basic training needs stemming from inadequate education or a lack of exposure to the electronic workplace.

With the dwindling number of young, entry-level white males, the categories of employees described above will be an extremely valuable resource to Federal agencies struggling to recruit and retain a talented workforce. Training and developing these workers is one of the most important challenges facing the training community (Johnston, 1988).

Workforce Values. The trends described in the sections above will produce a number of changes in workforce values. Many of the new generation of highly-skilled "computer babies" who are entering the labor market place high value on issues such as quality of work and the importance of personal and professional growth. One of the challenges facing the Federal government is to create a work environment and professional development programs that are seen as supportive of these values (Volker, 1989).

The issues of flextime and flexplace also involve value changes that are increasingly important to many employees. A 1987 survey showed that approximately 15.8 million corporate employees work at home either on a part-time or full-time basis (Kelly, 1988). One factor that will be likely to increase this trend is that the number of home computers is expected to grow from 18 percent today to as high as 70 percent by the year 2000. Further, approximately 75 percent of these home computers will be equipped for telecommunication (Cetron, Rocha, and Luckins, 1988).

Employees working at home or on flexible schedules may expect or need a similar approach to training. In addition, the proliferation of home computers offers a major training opportunity for all organizations, and particularly for Federal agencies faced with enormous

training demands and limited training resources. Distance learning, either group-paced or individual, can be distributed through these home computers, and combined with videotapes or audiotapes, using equipment that most employees will already have in their homes.

One of the training implications of changing values is that management training will need to address management issues and processes that previously were nonexistent, including more training in cultural awareness and cross-cultural communication, the management of telecommuting workers, and the management of changes in employee relations.

SUMMARY

Workplace. The types of technical and operational changes that can be expected by the year 2000 will have important implications for training as the IRS prepares to meet the 21st Century.

Training needs will be massive and continuous for the IRS to effectively prepare and manage a dynamic, new environment. Areas where need will be greatest are 1) computer skills, 2) new applications of technology to the IRS processes of data gathering, management, access, and analysis and 3) communications skills, both electronic and interpersonal.

Workforce. During the next decade, the workforce will stay at about the same size. Young, entry level workers will be in much shorter supply, particularly the highly skilled workers needed for more complex jobs. The composition of the workforce will change dramatically by the year 2000. Because of these changes, there will be a trend toward older, more mature workers, with increased reliance on women and minorities.

To remain competitive and productive, the IRS will need to provide a broad range of education and training programs for its employees. For some, this may take the form of direct job related retraining to acquire needed new skills. For others, it may take the form of basic skills training or high level professional development.

Many of the trends described above point to the need to deliver this training through flexible, tailored courses, delivered through a range of distributed systems. The next chapter describes some of the current and emerging technologies that will provide the needed capabilities.

Chapter 4 FACTORS IMPACTING IRS TRAINING: *PART 2. TECHNOLOGY, METHODOLOGY, AND ORGANIZATIONAL ISSUES*

INTRODUCTION

This chapter begins with a review of the important training technologies that have demonstrated their power and value for training delivery systems of the future. It continues with a discussion of educational theories and methodologies that will be crucial to the effective design and structure of technology-based instructional programs. It ends with a look at organizational issues that will need to be addressed as training, operational work, management, and information become increasingly entwined.

TRENDS IN TECHNOLOGY FOR TRAINING

In a time of rapid changes and advances in training delivery and content, it is difficult to talk about training "technology" in terms that are clearly understood by everyone. It is often unclear whether a term like "interactive videodisc" refers to a delivery system or a kind of instruction, or both. When does CBT stop being computer-based training and become an expert system?

Part of the confusion stems from the fact that computers and automation have erased many of the lines between training and operational work. If the computer is both a tool for training and a tool for the majority of operational work, then, ultimately, the two will merge. Training will become an ongoing process, rather than a separate event. The system will take on much of the role of "trainer," while the role of the instructional designer will be one of building the most efficient interactions between the learner and the computer, so that the training is of high quality and meets the needs of employees.

Even at its most advanced, computer-delivered training will never totally replace "live" instruction. Even the most sophisticated interaction between a computer and a human is unable to duplicate the interaction between humans that is vital to personal and professional development. However, the future will be one of more selection and choice. People will come together to learn when there are reasons to do so, not because there are no other options.

The second factor in the computer revolution that has critical implications for training is the changing role of information in the society itself. Western society is changing from an industrial base to an information and knowledge-based society. "Knowledge workers" are becoming today's equivalent of the production line.

One result of this large-scale shift is the accumulation of information, more information than has ever been available before. A related result is the organization of this information into huge databases, that store information about particular topics or fields. The main problem created by this vast accumulation of information is one of access; without the tools to find, sort, and process the information, it cannot be put to creative or productive use.

In response to the overwhelming need for access to information, powerful new tools and technologies have been, and are being developed. The capabilities of the computer and new optical mass storage systems are revolutionizing the ways in which information is organized, presented and accessed, not only for operational work, but also for learning. According to Ofiesh (1989), "We are on the threshold of having knowledge presented to us emulating the way we think rather than forcing us to think the way information is presented." Ofiesh points out that part of the value of the emerging new technologies lies in their potential to expand human capacity, to enhance human reasoning ability, and to process information in usable formats such that creativity will be facilitated and new insights and levels of thought will be reached.

Ofiesh (1989) notes that the new educational technologies will become increasingly transparent; that is, users will interact with the systems without awareness that learning is occurring and behavior is being modified. However, he also points out that the usefulness of the new tools depends on instructional designers and educators becoming familiar with them, and developing basic skills so that real proficiency can develop and the true power of the systems to enhance cognitive processes and to foster creativity can be realized. Educators must draw from a wide range of resources, both theoretical and applied, to develop curricula that fully utilize the interactive capability of the new tools.

In the following sections, training technologies are presented that hold promise as cost-effective and powerful means for meeting the massive new training needs. The technologies selected are in three categories, and include:

1. Computer Delivery
    - Computer-based Training (CBT)
    - Artificial Intelligence (AI)/ Intelligent Computer-assisted Instruction (ICAI)
    - Hypertext/Hypermedia
    - Embedded training

2. Conferencing
   - Asynchronous computer conferencing (ACC)
   - One-way videoteleconferencing - broadcast or cable station
   - Two-way digital videoteleconferencing

3. Optical Disc Technology
   - Compact Disc — Read-only Memory (CD-ROM)
   - Digital Video-Interactive (DVI)
   - Compact Disc-Interactive (CD-I)
   - Interactive Videodisc (IVD)

Basic technical information and potential applications to training are listed, followed by examples of current applications and expectations for the future in terms of continued development and anticipated advances.

Some of these technologies are primarily delivery systems; some are storage media; others are applications. They have been broken out for separate discussion because each has specific characteristics that are seen to be important to current and future training. However, one of the key points is that they are becoming interrelated in both concept and application.

For instance, optical disc technologies and storage media such as interactive videodisc, CD-ROM, and DVI are moving into the forefront of new applications like hypermedia.

The difference between computer-based training (CBT) and interactive videodisc (IVD) today is the absence of full-motion video images as a way of presenting information in CBT. The emerging CD-ROM technology will store all types of data, including video. At that point, today's discrimination between CBT and IVD will disappear, and new terms will have to be devised to refer to both delivery method and instructional design.

Because of rapid development and a lagging knowledge base of common applications, there is still confusion over terms and applications. "Artificial intelligence" and "embedded training" mean different things to different professional communities. "Computer-based training" is sometimes used as a generic term to describe any type of instruction that involves a computer. Others mean a specific type of instruction.

In the following discussions, terms are defined as clearly as possible. However, the amount of overlap, and the fact that it still may be difficult to separate these technologies into discrete groups, are important points in themselves.

COMPUTER-BASED TRAINING (CBT)

What It Is

Because computer-based training incorporates a wide range of concepts, techniques, media and technologies, it is often unclear exactly what is meant by CBT. For this discussion, the following definition will be used:

CBT is "an interactive learning experience between a learner and a computer in which the computer provides the majority of the stimulus, the learner must respond, and the computer analyzes the response and provides feedback to the learner" (Gery, 1987).

This definition includes interactive video and other multimedia systems when they are computer-driven. The key words are "interactive" and "computers." The computer permits interactivity to a degree not possible with any other instructional approach, except perhaps one-on-one dialogue between teacher and learner.

The most common CBT programs consist of generic or custom software on a floppy diskette that runs on a personal computer. Main-frame or mini computers can run CBT lessons for a number of learners simultaneously. In these cases, Computer Managed Instruction (CMI) is usually included to monitor learner progress on line and to print out reports of individual progress and results of tests.

Training Applications

The computer brings a number of specific capabilities to the training delivery system. These should be assessed in relation to the training needs that must be met. These capabilities include:

- the creation of files for storing information;
- the organization of text, video, and numerical data ;
- random access to data and program;
- the manipulation of variables and the calculation of outcomes;
- the creation of linear, conditionally branched, or non-linear interactions;
- the evaluation of student responses and decision-making based on this performance assessment.

Instructional designers and trainers can make use of the capabilities of CBT technology to provide a wide range of learner control options and levels of interactivity that permit a higher degree of individualized learning than is possible with other delivery methods and media. However, CBT can also provide high levels of program control, as appropriate, depending on the training application and the characteristics of the learner.

Considerations

Points to consider concerning CBT training systems include:

- Interactivity and learner control are the primary factors that separate CBT from traditional instructional media. There should be sufficient interactivity in a CBT program to add teaching value beyond what can be achieved with other media.

- The visible, often high upfront development costs of CBT may be a deterrent to its use; however, CBT has been shown to be extremely cost-effective over time, in terms of total costs, time savings, and training effectiveness.

- Some CBT courseware is complex enough to require an administrator or facilitator for such things as student identification and registration, and the loading of courseware; other courseware requires only a log on. The simpler the access to and use of a program, the more likely it will be used and reused.

- CBT is primarily an individualized instruction medium; one of its most valuable uses is as a personal tutoring system. However, CBT can be used very effectively in conjunction with other media and methods. For example, CBT lessons can precede group discussions or lectures in classroom training.

- CBT permits individualized, self-paced, consistent instruction and delivery at individual workstations. This generally results in significantly reduced training time. On average, industry reports a 30% savings in time when similar training is converted from the classroom to CBT (Hart, 1987). A built-in student management system also simplifies recordkeeping and administrative tasks.

Examples of Current Training Applications

Computer-based training systems have been incorporated into the training of many government agencies, businesses and industries. The U.S. military is already fully committed to CBT as a cost-effective training delivery methodology, and has developed many programs in a wide range of subject areas. CBT is being used to teach a variety of knowledges and skills, from adult literacy to factory processes to management and sales techniques, and has proven its effectiveness in many different settings and training environments. CBT is also used extensively to develop proficiency in the use of various software packages, including financial, word processing and desktop publishing programs.

- Nationwide Insurance, Prudential Insurance, and other investment companies are using CBT to help agents prepare for the

Series 6 exam, a computer-based licensing test administered by the National Association of Securities Dealers (NASD). The test, given nationwide at Control Data Corporation's 60 PLATO Development Centers, must be passed before a broker may sell mutual funds, annuities, and limited securities. A CBT program, "NASD Series 6", from Educational Training Systems, Southboro, MS, utilizes a tutorial and drill practice to help students master the material. First-time pass rates at Nationwide have risen from 60 to 97% as a result of the CBT training; at Prudential, pass rates rose from 68 to 90%.

- Martin Marietta Electronic Systems in Orlando, Florida, recently implemented a state-of-the-art Computer Integrated Management System (the Automated Planning, Execution and Control System, APECS). This fully automated system consists of four large computer software systems that interface in real time with the entire manufacturing process, controlling all planning, production, inventory and shipping operations. CBT is the primary mode of instructional delivery for production operations and material, and includes student certification and testing.

- Westinghouse Hanford Co. (WHC) makes extensive use of job-task simulations in CBT courseware developed in-house. These training programs model day-to-day tasks such as physical work preparations and procedures, safe practices and incident handling, with each simulation reflecting some physical process. The WHC simulations model the basics of good industrial practices for training and testing.

- Southern California Gas has implemented a CBT program to train employees on its new Customer Information Billing System (CIBS), designed to expedite billing services for its 4.2 million customers. Wicat Systems, Orem, UT, developed the single computer-based training course that contains 16 hours of modular instruction that can be tailored for each training application. Because the course is self-paced, and students are involved only in the portions required for their jobs, the training can be completed within 6 hours. As a result of the CBT training, Southern California Gas has realized a 50% savings in training costs, reduced training time by 70%, eliminated travel and lodging costs and for trainees, eliminated time off the job while training, and realized a faster and more comprehensive retention of the material. In addition, after training, trainees were able to use the new Billing System successfully without further instruction.

- Guardian Life Insurance Co. in New York uses off-the-shelf CBT courseware to train its managers in goal setting, evaluation of office performance, planning of project strategies and improving basic math and writing skills. Guardian has also

developed custom CBT programs for its claims and sales departments. The learn-test formats not only speed learning and help trainees retain the material, but also assure that every employee receives the same information presented the same way. Guardian has also found that, when cuts in staff were necessary in some claims offices, the CBT training compensated for the loss of experienced workers and maintained productivity with fewer people.

Expectations for the Future

Over the next decade, CBT systems will become widely used in training programs, both large and small in scale. New programs, both generic and customized, will be developed to train in a wide variety of topic and skill areas.

Technological advances, particularly in the areas of greater computer memory and operations capability, and in the development of the optical disc technologies, will enable CBT training systems to expand significantly. By combining many of these technologies, the resulting systems will have analog and digitized video, enhanced graphics, mass storage, digitized audio, expert systems, and embedded training capabilities.

These capabilities are currently being applied to training situations. Although they have not all been fully developed and tested, they offer the potential for providing creative new training approaches. As instructional designers and course developers become more familiar with the new technologies, and explore the possibilities of their use, we can expect to see further use of technology in training.

There are several technological advances that will influence how courseware is developed in the future. Previously, courseware development was a very labor intensive endeavor requiring numerous development hours to produce one hour of courseware. If technology is to have a significant impact on training, then the time required to produce courseware to run on the newer technology must be reduced.

One obvious way to reduce development time is through automation of some aspects of the development process. Courseware authoring systems allow users to create CBT courseware without having to write the computer code. These systems automate the code development process and shorten the overall development time. More elaborate expert systems attempt to automate steps in the training development cycle from needs assessment and task analysis through media selection and evaluation. Expert systems for task analysis and media selection currently exist.

At a less complex level, novice training developers will be able to use IF...THEN type job aids to help them make decisions about

training. These job aids take the training developer through a series of decision trees to help them decide how the instruction should be developed.

Numerous graphic tools exist and can be used in courseware development. Graphic packages can be used to create images to be placed in CBT lessons. Images from graphic libraries or clip art can be copied directly into CBT lessons. These images can also be modified to fit the needs of the designer. Text can be placed on the images if necessary, and the images can be resized.

ARTIFICIAL INTELLIGENCE

What It Is

Artificial Intelligence (AI) is the name given to the types of computer programs that have the ability to "think" in terms of responding to user input and providing information based on user queries or user responses. These programs may be structured either as job aids that emphasize problem-solving applied to specific tasks (Expert Systems) or as training programs. AI-based training programs are called both Intelligent Computer-Assisted Institution (ICAI) and Intelligent Tutoring Systems (ITS). Regian and Shute (1988) define an Intelligent Tutoring System as "a computerized instructional system that makes use of AI programming techniques to enhance instructional effectiveness." Since this is an identical definition to ICAI, only the term ICAI will be used in this discussion.

In general, Expert Systems represent a broad category of AI software that organizes and applies the knowledge of human experts to specific problems (Vitalo and Narkus-Kramer, 1987).

Expert Systems for operational work often take the form of troubleshooting packages that allow the user to input symptoms or examples of the problem in response to prompts. General Motors has developed a program for mechanical troubleshooting called CHARLIE. In a widely-distributed TV advertisement, the original Charlie is shown as a highly experienced mechanic who has the intuitive knowledge of what is wrong with a car based on a lifetime of experience. Charlie's expertise was captured and developed into a series of prompts and suggestions that helped a mechanic work through a narrowing range of possible problems.

ICAI incorporates a number of techniques and instructional approaches to assemble and organize a comprehensive knowledge base

into an instructional model according to clearly defined rules or paradigms derived from expert educators and trainers.

Along with the knowledge base of facts, principles, concepts and methods associated with the topic of instruction (domain model), an ICAI system also contains the following models (Regian and Shute, 1988):

- a student model that uses the learner's performance to determine what the learner knows and/or how he/she is thinking;
- an expert model that organizes the human expert's knowledge base into problem-solving approaches or ways of thinking about the topic;
- a tutorial model of instructional principles and strategies that develops an instructional presentation to the learner, based on the learner's performance; and
- a presentation model that interfaces with the learner.

Thus, ICAI can be seen as a combination of computer science and cognitive psychology.

Training Applications

An expert knowledge system that uses AI technology consists of three basic components: a subject matter knowledge base, an inference engine, which is a method for using or applying knowledge, and a user interface, which permits interactivity between system and user. An expert *training* system (or ICAI) requires an instructional component added to the technical knowledge base and a learner model to the inference engine component. While a number of expert knowledge systems exist or are being developed, the instructional component and learner model required for ICAI are still at the experimental stage.

Existing expert systems can be used for training if the instructional component and learner model are provided by instructional designers and trainers in the context of specific training environments. Thus, the expert systems currently being developed in the IRS AI Lab could be adapted for training applications without further programming breakthroughs. IRS trainers can use the existing knowledge base to develop training scenarios and instructional contexts that make full use of the problem-solving approaches of experts.

Certain kinds of knowledges and skills are prime candidates for development into expert training systems (Schmidt and Lazar, 1989). These are:

- models of good performance;
- clearly identifiable and visible data/decision-making strategies;
- tasks requiring repetitive cognitive practice.

Another promising application of AI technology to training is in the actual training development process itself. As stated earlier in the chapter, several efforts are underway to develop expert systems to guide and assist people in designing and developing training. The knowledge of expert task analysts, for example, can be captured in an expert system and made availiable to less skilled and less experienced persons completing a task analysis. Expert systems are being developed for planning instructional strategies and identifying important instructional guidelines. Other expert systems have been developed for media selection and task analysis.

There are several efforts underway to automate some aspects of training development. The Army Research Institute (ARI), IBM, and other organizations are currently supporting efforts at automating training development. The intent in these efforts is to reduce the time and expense of developing training by providing software "tools", sometimes incorporating AI features that automate certain steps in the training development cycle. An example of such an effort is software that automates storyboarding and scripting interactive videodiscs. Another example is software that automates the authoring of CBT lessons. There are several software products that automate task analysis. Products such as these will become more widely available within the next five years. IRS training developers should be able to use such automated tools and create their own customized versions, to enhance their design and streamline their production of training programs and materials.

Considerations

As expert systems are applied to training, some considerations are:

- When designing or adapting an expert system for training, the functional environment changes from real-time to an instructional mode. The ability of the learner to access real data or programs during training scenarios needs to be determined.

- Cost-effectiveness issues center around consideration of the time and money involved in developing an expert system. It is not unusual for a complex system to take two to four years to develop and to cost between $50,000 and $900,000 (Regian and Shute, 1988).

- The ease of correcting an expert system after evaluation should also be considered. The more rigid architectures make it "virtually impossible to redesign and reimplement" a system after evaluative testing (Regian and Shute, 1988).

- Training departments need to develop expertise in expert systems and become involved in their development within the organization. The mission of the training department may change from the dissemination of knowledge and skills only and include "employee development through the generation and dissemination of expertise" (Vitalo and Narkus-Kramer, 1987).

Examples of Current Training Applications

Applications of true ICAI are currently limited. Many systems have been developed to demonstrate the feasibility of expert systems in training, but they are not yet being used in viable training programs.

- STEAMER is an expert training system developed to show the feasibility of teaching the propulsion system of a naval vessel and of allowing the student to manipulate the system safely in training (Waterman, 1986).

- GUIDON was developed to adapt a bacterial infection diagnosis expert system (Mycin) into a tutorial system for medical students (Waterman, 1986). This program leads students through a series of questions and prompts about presenting symptoms and possible causes, allowing the student to query for more information and to present tentative diagnoses for evaluation.

- WEST teaches basic mathematical skills, compares expert solutions to learner solutions, diagnoses the learner's misconceptions and applies pedagogical strategies to present further instruction (Wenger, 1987).

- MATTIE teaches diagnostic troubleshooting in complex electrical systems. The program allows the learner to alter the system and play "what-if" games, then see results and effects on the system (Jones et al., 1987).

- EXPERTAIR is an expert system that analyzes tactical air situations and provides expert recommendations for actions. It specifically demonstrates the feasibility of interfacing with an external database to receive information needed for its judgments (Sivasankran and Molidor, 1987).

- SCOPE is a Smart COntract Preparation Expediter under development by the Army for inclusion of the requirements called for in the Army's MANPRINT (Manpower, Personnel,

and Integrated Training) program in Requests for Proposals. This system queries the RFP preparer on each of the human factors engineering items that must be included in four separate sections of an RFP (J. Lowry, personal communication, 5/12/89).

Expectations for the Future

ICAI technology is developing and will become even more sophisticated as it is applied to complex training situations that require development of both procedural and cognitive skills. It is expected that, by 2000, expert training systems will be operational in a wide variety of training environments.

The development of AI software and the application of new programming techniques to expert training systems are already advancing the technology for use in training. For example, expert systems can be programmed not only to guide the learner in mastering the expertise of human experts, but also to "learn." New information can be entered and stored in the system knowledge base, and trainee interactions with the system can be analyzed and used to develop new rules for correctly solving problems. This capability has relevant application to any complex cognitive task that requires high level thought processes and decision-making skills.

Both the hardware and development costs of expert training systems make them expensive at present; however, it is expected that costs will decrease as the technology advances and becomes more widely applicable. It is predicted that, as soon as optical discs can be erased and rerecorded, these storage technologies will become standard peripherals for all microcomputers, thus making expert systems generally available (Ofiesh, 1987). It is also expected that the time required for development of a complex expert system will also decrease in future. However, as with all technology, the development costs of expert systems will always be higher than the development costs of relatively unstructured classroom training. The payoff will be in lower delivery costs and in improved productivity and accuracy of well-trained employees.

New training products constitute another area in which significant change is expected. "Smart tool kits" will support task performance by guiding the user. "There will also be a shift from paper-based desk references to online small expert system advisors which assist employees in working through the application of policy and procedure rather than simply display policy and procedure" (Vitalo and Narkus-Kramer, 1987). In addition, simulators will continue to be used extensively, but in the future will include models of social and psychological phenomena as well as physical systems.

Work in the field of artificial intelligence will continue to have an impact on training development. Expert system software is but one

example of this influence. Advances in natural language processing will enable computers to understand or make meaning from typical human speech. When coupled with speech recognition, advances in natural language processing could make human-computer conversations possible. With this kind of interface, computers could become even more valuable and versatile training devices.

HYPERTEXT/HYPERMEDIA

What It Is

Although the concept behind hypertext is not new, hypertext as a popular computer technology has developed only recently. A hypertext document is a collection of computer files, also called "stacks", made up of different "cards" containing information that can be accessed in a nonlinear way. The term "hypertext" is used when all of the information in the files is in textual form. However, since the computer can access various optical and audio storage devices (both analog and digital), files may also contain graphics, animation, audio, video, and even other programs such as word processing, or spreadsheets. To distinguish such a multi-media capability, the term "hypermedia" was coined.

Users of hypertext/hypermedia systems can trace variable paths through the material, choosing which stacks and cards they will view, and in what order. For example, in ABC's program "Vote '88", on the 1988 presidential campaign, users can see each candidate's stand on a certain issue or browse through varied information about one candidate. A system at the Smithsonian Institution contains images of the complete 1500-piece collection at the National Gallery of Art; system users can explore works by one artist or from one time period, may discover works containing particular objects or themes, or may call up a video presentation by a museum professional on a selected work. Thus, hypertext/hypermedia is an information environment that is controllable, either by the user or the program. It may serve as a passive resource from which information may be retrieved, or as an active resource that can be structured and manipulated. The user has immediate access to any piece of data in the database, and may interact with and relate information as desired.

The three elements of a hypertext/hypermedia system are the individual files (also termed "nodes" or "fields"); the links (also termed "buttons") that connect the files; and the user interface. The files make up the database, which can vary in size from a single document to a large, multi-volume, multi-media library. Any file in the database can typically be accessed within a second.

The links form the cross-references within the database, serving both as references within files and as bridges between files. Links are typically indicated by symbols or by highlighting a relevant word. The user interface includes screen formats, commands, and any other items that facilitate system use.

Hypertext/hypermedia systems have the following characteristics (Jonassen, 1989):

- nodes, or fragments of information;
- associative links between nodes;
- network of ideas formed by the link structure;
- organizational structure that describes the network;
- ability to represent explicitly the structure of information in the structure of the hypertext;
- dynamic user control of information;
- high level of interactivity with user;
- database-like storage structure;
- multi-media information environment; and
- multi-user access to information.

Training Applications

Because of their organizational flexibility and the ease with which users can develop applications, hypertext/hypermedia systems are being used in a variety of ways, including training and education applications. The technology is well-suited to high levels of interactivity and learner control. In this context, hypertext/hypermedia facilitates learning because its access and information structures closely resemble the learning process in terms of the cognitive skills that are developed and the cognitive processes that occur (Jonassen, 1989).

As Jonassen points out, the learning process involves the continual construction and reorganization of knowledge structures that reflect the ways in which facts, ideas and concepts are organized in memory. Hypertext/hypermedia technology provides a flexible learning environment that directly reflects the thinking/learning process.

For example, in a program for middle school students, developed by Lucasfilm Inc., the National Audubon Society and Apple Computer Inc., students are asked to solve an ecological problem involving the disappearance of ducks from their marshland habitat. Students can explore this issue through the hypermedia program by accessing data from the park ranger's files; interviewing experts; listening to hunters, wildlife specialists and housing developers; viewing presentations on duck biology and habits; and by conducting chemical and biological experiments on the marshland. This example illustrates

the high degree of control that students maintain over their own learning as they develop their cognitive skills according to their individual styles and needs.

Considerations

Hypertext/hypermedia technology is only beginning to be developed in training applications. While the potential is there, the following considerations should be noted:

- Users may find it somewhat difficult to navigate through the information successfully. Some program designs provide little or no guidance to the user on how to access or route through the material or how to decide on an approach that will meet their learning needs. However, these design issues will be overcome as effective instructional design methods are employed, and as research on system use reveals optimal learner strategies and access patterns.

- Development of effective hypermedia programs is complex and expensive. Costs associated with obtaining video sequences, developing software, and designing programs are high at present; however, as hardware costs decrease, and as development expertise increases, hypermedia systems should become more generally affordable.

- Since hypertext/hypermedia is a new technology that places many demands on the user, some level of learner expertise is required before effective use can be made of the systems. These issues will need to be addressed by program designers.

- The use of conceptual models of knowledge acquisition can help designers structure hypertext programs to reflect the sequence of events that occurs in information processing. For example, the chunking of information nodes into conceptually related units will help reduce the cognitive strain on the learner to assimilate information.

Examples of Current Training Applications

While still generally experimental in nature, some hypertext/-hypermedia programs have been developed in training and educational environments.

- Apple Computer has developed a hypermedia accompaniment to John Steinbeck's novel, "The Grapes of Wrath", now being used at Lowell High School, San Francisco, California. Called "Grapevine," the program contains Depression-era radio programs, photographs, film footage and magazine articles.

Students can use the system to study a wide variety of aspects of life in America during the period of the novel. In addition, students can access music of the era; agricultural data such as crop yields, climatic conditions and federal-aid programs; and the speeches of President Roosevelt.

- Within the U.S. Environmental Protection Agency (EPA), the Office of Underground Storage Tanks has published a set of regulations in a hypertext format. The project, entitled Reg-in-a-Box, was designed to make regulations more understandable to the people who must comply with them. Users of the program can access cross-references and explanations, as well as a dictionary of terms and a phrase search. Another version of the program, called Reg-Soft will add a schedule of reporting dates, a telephone directory of EPA officials, and the preamble to the regulations that explains the context of each.

- At Stanford University, a hypermedia program has been developed on the works of Shakespeare. Students can call up film clips of a scene on a video screen, freeze the action to refer to the printed text, switch among different performances of a work, replace the original soundtrack with interior character monologues, or study the mechanics of acting.

- At Stanford University School of Medicine, several doctors have created a hypermedia anatomy program called Electric Cadaver. By moving the cursor on the computer screen, students can move through thousands of anatomical photographs. Working with images, the learners can manipulate the human body in ways not possible with real subjects; for example, the student can paralyze a facial nerve and instantly see the result on a human face. Other medical hypermedia programs are in use at Cornell University Medical College.

- A hypertext system developed at the University of Maryland was used to create an informational browsing system for public use at a Smithsonian exhibit on Austria and the Holocaust.

Expectations for the Future

The capability of providing random access to information offered by hypermedia systems is expected to result in new understandings of how learning occurs and how knowledge is acquired. This modularity and ability to juxtapose concepts might increase comprehension over the forced linearity of traditional textual presentations. New styles of remembering and of knowledge transfer may evolve which can be used in training program design.

Hypertext is primarily viewed as a way to structure and deliver information to the user that allows the user considerable control over the sequence. More information will be made available in a hypertext/hypermedia fashion in the future. Both Jonassen (1988) and Ofiesh (1989) see an expanded role for hypertext/hypermedia in which systems become tools for the user to record what he/she knows. In this sense, hypertext/hypermedia systems become personal databases to help the user store, organize and retrieve information.

EMBEDDED TRAINING

What It Is

When a person uses a computer in his/her work, whether for word processing, spreadsheet analysis, or other applications, training in the use of that application can be delivered by the computer as the person works. Such training is called "embedded" training since the training material is located or "embedded" in the applications software. When the person using the application program encounters a problem, the embedded training explains what to do and how to do it to resolve the problem.

Concurrent training is a variation on this theme of providing training during the use of applications software. In concurrent training, the computer-based training material resides in its own program which is running alongside, or "concurrent" with the applications software. With both embedded and concurrent training, the person receives training at his/her workstation when it is needed. The training is integrated with the work such that a person moves freely from work to training, then back to work. The distinction is whether the training material is an actual part of the applications software (embedded training), or is a separate program running at the same time (concurrent training). To the user, however, both appear to respond in the same manner.

The embedded or concurrent training can range from simple "help" assistance to a full-blown tutorial that teaches a novice how to use an applications package. A user can be led through a simulation exercise to practice using the applications package, or he/she can receive the training only by asking for it. Some embedded/-concurrent training programs evaluate each keystroke made by the user of an applications package and provide training for specific errors the user makes. If no errors are made, the person continues along in the application.

Training Applications

Embedded/concurrent training is a natural evolution of the automation of many work processes. When the workstation is a computer, training on the system itself is a logical and efficient approach. An added benefit is that problems of skill transfer from the training environment to the work environment are lessened, particularly if the training is written so that the learner's use of keys and processes during the training are identical to work applications.

One of the driving forces toward embedded training is that many new users of computers and micro-processor controlled devices are not technical personnel, and have had no prior exposure to the broad range of new skills and concepts that must be mastered before productive work can begin. Secondly, many users of automated systems today want a high degree of control over the equipment and programs they use (Kearsley, 1984).

Embedded training will provide the new system user with immediate hands-on experience with the equipment; as the user gains skill and confidence, proficiency on the system increases significantly.
Embedded training systems also enable the user to progress systematically through multiple levels of training objectives. This feature makes it possible for any student, regardless of entry level skills and knowledge, to enter the system at the appropriate level, to meet his/her training needs, and to progress to the next level when ready. One goal of embedded training is to provide a method of dealing effectively with training problems at any level (Baker, 1986).

A third characteristic of embedded training systems is that they serve to maintain proficiency in system use after the student has completed training on the system. Thus, such a system functions both as a training vehicle and a maintenance vehicle.

For Kearsley (1984), there are three basic types of embedded training: helps, simulations, and intelligent tutors. This is a prime example of the current confusion regarding terms and applications. "Intelligent tutors" that require AI programming were discussed in the previous section on artificial intelligence. Help and simulation applications are discussed here.

Help may be provided in several ways. In fixed format helps, the same message always appears, and is usually an explanation of a command. Context-sensitive helps depend on the user's action, and provide information about the specific current activity. Prompts are generated by the system rather than by the user and display the correct syntax or parameters for a particular command string. Query-in-depth helps provide multiple levels of response, with each level offering more detailed information than the previous one. Dialogue helps allow the user to ask questions and receive information back.

Simulations have long been recognized as an effective training method that provide active learning and a high degree of practice. Since it is now recognized that a high degree of realism is not necessary to provide an effective learning environment, embedded training can include simulations in CBT formats. The key to a good simulation is the creation of appropriate exercises and problem-solving situations by the instructional designer (Kearsley, 1984).

Considerations

- Because of the confusion over what the term means, a decision to use embedded training needs to be preceded by a clear definition of both the content and the types of training that are to be considered for embedding. Both operational planners and trainers need to agree on the way embedded training should be defined, planned for, designed, implemented, and evaluated.

- The major considerations in whether or not embedded training is called for is the nature and complexity of the automated system itself, and the capability and experience of the employees who will be using it. Analysis should include such factors as similarity to other systems in terms of user interface, functions, and processes, complexity of tasks, and prior training or experience of planned users.

- Embedded training must be planned for in the system design stage. Insufficient memory and storage capacity are difficult problems to solve after the fact. Up-front planning for embedding training into operational systems that run on mainframe or mini-computers is particularly critical.

- User- and context-sensitive programs are probably the most effective in terms of positive learner response and individualized instruction that can be accessed depending on user experience and the task to be performed. However, this type of embedded training requires the highest level of design and programming expertise.

Examples of Current Training Applications

- The military has been at the forefront of embedding training into computer-based systems ranging from sophisticated weapons to automated record-keeping processes.

- Major hardware vendors, including IBM and DEC, are offering embedded training programs for both system training and application software.

- Tutorials are embedded in a broad range of commercially available software, including word processing, data entry, database management, typing skill, project scheduling, and resource management. Many organizations, including federal agencies, have adapted these products for their own use through slight, and inexpensive, modifications.

Expectations for the Future

The proliferation of automated systems that will continue into the next century is going to continue to present a great challenge to the IRS in terms of training. Embedded training, using any or all of the current definitions, is a promising solution. At the least, novice users can become familiar with system functions and procedures on the machines themselves. Online tutorials for common problems could reach many employees simultaneously with standardized training.

Part of the value of embedded training systems for the future lies in their ability to accommodate artificial intelligence (AI), or intelligent computer-assisted instruction (ICAI). Perhaps the most feasible approach would be to use tutorials and help prompts initially, and augment them with AI and/or expert systems technology as embedded job performance aids.

ASYNCHRONOUS COMPUTER CONFERENCING

What It Is

Asynchronous computer conferencing (ACC) is primarily a computerized delivery system, but it is unusual in that its primary use is not to provide human-computer interaction as in CBT. It is used to provide instructor-student and student-student interaction in an "electronic classroom" setting. The instructor and students meet online from individual computers scattered around the country or around the world.

It is an "asynchronous" classroom in that the instructor and the students do not have to be at the same place at the same time. Questions, test answers, project papers, or individual responses to a discussion question are stored by the conferencing software until it is convenient for the student or instructor to be at the computer and dial up the classroom through a modem.

Just as in a "normal" classroom, course information can be presented in various media. The most common approach is for text-based materials to be sent out to the students, either through the mails or electronically, and down-loaded at their individual computers. This information is sometimes augmented by videotape, audiotape, or CBT programs to be run on the student's computer.

The role of the instructor is the same as in a live classroom, and includes classroom management, taking attendance, making assignments, forming student work groups, answering questions, and posing topics for classroom discussion. A topic is entered as an "item," viewable by all students. The software sorts and stores student responses by item in the order they are made. The equivalent of electronic mail is also available for private messages between instructor and student or between students.

Class discussion, individual help sessions, quizzes, and group projects are conducted on the computer. Because of the expense of transmission costs, most of the applications today allow students to down-load activities into their own computers, work on the material, then up-load again for transmission back to the host computer.

The only special requirement for ACC is a host computer capable of running a conferencing software package, and telephone lines for access from student modems. Software packages such as CoSY and CAUCUS come in various versions for different operating systems and storage capacity. At this stage, graphics cannot be transmitted on the software. However, new versions in development will add this capability by 1990.

Training Applications

Computer conferencing is a fast-growing application of computers and telecommunications for distance learning. It is applicable in any training situation where resident training is not possible, and where correspondence courses are not considered satisfactory by themselves.

One of the strengths of an electronic classroom is that experiential learning through questions and reflection is encouraged. In a live classroom situation, time and structure can inhibit questioning. Also, live classroom questions are almost always spontaneous. In the electronic type of interactive setting, time constraints and interruptions by others are removed. Questions can be carefully crafted, and responses can be contemplated and equally carefully crafted.

Britain's Open University offers a full range of distance learning programs, including courses of study at the Ph.D. level. Many of these programs use a combination of video presentations similar to PBS "Sunrise Semester" courses, correspondence materials, and ACC. The administrator of the Open University's ACC programs has

identified the kinds of courses most suitable for computer conferencing (Kaye, 1985). They are specialist and advanced level courses:

- that require frequent revisions to be kept up to date;
- that require expert instructors that are in short supply; and
- that are attended by advanced students who already have a body of knowledge and experience from which to contribute to the course discussion.

Another use of computer conferencing is in lesson preparation and design. Subject matter experts can be brought together electronically from across the country to provide initial information, to critique instructional content and design, and to work interactively on what constitutes expert performance. The Army War College currently uses such a conference of retired general officers as a "living expert system," on a conference called LEXSYS to assist with course content and redirection. These retired offices are widely dispersed around the country and often busy with civilian careers. This method has allowed their frequent participation, and has been a critical resource.

Computer conferencing is also valuable as an instructional management tool and to update and train remote instructors. Student scheduling and progress can be discussed online by instructors and planners scattered across the country. In addition, trainers can be informed immediately of changes in course content due to changing regulations or procedures.

Considerations

Other points for consideration with computer conferencing are:

- With the exception of graphics enhancement, ACC uses mature technology, operating with virtually any computer terminal equipped with a modem over ordinary phone lines.
- The approach involves low development and maintenance costs, because courses are usually adaptations of already existing instruction, either residential or correspondence.
- ACC is particularly adaptable to courses that include class discussion or group projects, in addition to individual study.
- Telecommunication costs can be high, but can be kept to a minimum by down-loading material from the conference to the individual computer, working offline, and then up-loading only to telecommunicate.

- Instruction in this medium may be difficult for instructors more comfortable with face-to-face lectures and interaction. Student interaction has to be encouraged and managed in similar ways, but through typewritten words only, rather than visual cues.

- Some individuals are uncomfortable with computers and written communication, rather than verbal interaction.

- Like any individual instruction, the method requires time and self-discipline on the parts of individual learners.

Examples of Current Training Applications

Colleges, universities, private institutes, business, and the military are using ACC for education and training to manage and augment information presented in other media.

- Electronic University Network (EUN) delivers over 200 accredited courses via computer conferencing for over 200 colleges and universities. These courses meet or exceed College Level Examination Program requirements, and are transferable to over 1700 colleges and universities.

- New York Institute of Technology operates the American Open University, offering over 130 accredited courses and three B.S. degree programs.

- Boise State University is developing an M.S. program in Instructional Technology to be offered via ACC in Fall 1989.

- Western Behavioral Sciences Institute offers the School of Management and Strategic Studies online to selected top corporate and government executives. World renowned authorities lead seminars and discussions in a two-year program of international policy issues. The program has been compared to programs such as Harvard Business School's Advanced Management Program, MIT's Program for Senior Executives, and Stanford's Executive Program (Rowan, 1983).

- The U.S. Army Research Institute is conducting a two-year pilot study of electronic delivery to reserve officers of the Advanced Officers Engineering Course. The subject matter expert was located at Ft. Belvoir in Virginia, the instructor in Idaho, and the students, across the nation. The course has included group projects, in addition to exercises and group instruction. In this case, the "electronic classroom" has been expanded to an "electronic school." The screen that comes up at student log-on shows a number of "rooms," including classroom, skills lab, teacher's office, small group activity room, and

student lounge. CBT programs and other exercises are available for student practice in the skills lab. The teacher's office is the site of individual tutoring.

Expectations for the Future

Over the next decade, more and more computers are going to be available and equipped with modems that allow computer conferencing. Also, it seems likely that individual instruction will grow, with materials presented in a number of media. Computer conferencing will likely grow as an educational management tool, allowing instructors to interact with students to answer questions and lead the types of discussions that will integrate lessons completed in other media. The development of a graphics capability will expand the kinds of materials that can be sent online as part of course packages and online discussions.

All of these factors are encouraging to the continued growth of computer conferencing as a delivery system and adjunct to other media in individual learning "suites."

ONE-WAY VIDEOTELECONFERENCING

What It Is

This form of teleconferencing uses broadcast-quality video with a voice link back to the studio to provide interactivity. For wide distribution, the signal is usually broadcast via satellite transmission. An analog signal is transmitted from a broadcast studio, and received at "downlink" sites distributed across the country.

Two-way audio is provided by audio "bridges," similar to a conference call. Until recently, receiving sites often had to turn down the sound on the transmission before calling in questions to avoid disrupting the broadcast with audio feedback. Newer audio bridges are making interactivity easier and more satisfactory. Some receive sites are equipped with sound activated microphones that allow more natural discussion, while others still involve dialing a phone or other means of access.

Training Applications

Teleconferencing allows interactive delivery of instruction and information to many people distributed across the country. This is particularly important to a large, geographically dispersed organization like the IRS that may have rapidly changing regulations or procedures that need to be distributed to the field quickly and accurately. Information can be broadcast live by the subject matter experts who are able to answer questions and make sure that complex changes are understood.

When immediacy is the issue, teleconferencing is still seen as the most efficient way to distribute information. For an example, during the stock market crash in October of 1987, Merrill Lynch used private television broadcasts to contact brokers scattered across the country. Industry spokesmen were quoted as saying that the savings could not be measured (Ross, 1988).

In addition to live broadcasts, there are now prepackaged satellite networks which deliver industry-specific programming directly to corporations and institutions (Levine, 1989). For a fee, business sites equipped with downlinks can access video networks that provide regularly scheduled training programs and special pay-for-view events. Currently, there are between 30 and 40 networks, including the American Law Network, the Bankers Television Network, the Computer Channel, Inc. Network, and the Law Enforcement Training Network. To illustrate, the Vienna, Virginia Police Department is paying $388 per month to receive the Law Enforcement Training Network, consisting of police news and training programs, 24 hours a day, six days a week. General topics include crime control, civil liability, officer survival, and job-related stress. The growing number of networks offer many courses in technical, managerial, and academic fields that would be of interest to IRS.

The technology is being used to broadcast a wide range of training programs, particularly to businesses with distributed sales or maintenance personnel. This application has become so popular that the name "business television" has become a synonym for this type of training distribution.

Agencies such as the Federal Emergency Management Agency and the Social Security Administration have established their own networks between the headquarters and field offices for information distribution, management development, and technical training, and the military services are using the technology for coordinating meetings and training.

Considerations

- Tangible cost savings can result from reductions in training-related travel and per-diem. In addition, scarce instructors and subject matter experts can be made widely available to a large audience.

- The amount of interactivity actually experienced is an on-going concern for instructional designers and instructors. Careful design must be used to build in opportunities for interaction. The audio link itself can be intimidating to many students. Courses can become more like an extension of an auditorium-style lecture, with few calls coming in. In courses that are distributed to large audiences, most experts believe that very few calls actually get through. Ron Zemke of *Training* magazine estimates that a trainer probably gets a tenth of 1 percent of calls attempted (Ross, 1988).

- The quality of the visual image at the receiving sites is an important consideration. A number of sites use video projectors to show the picture on wall-size screens to accommodate large audiences. In courses where the visual image is important to the instruction, this technique has been found to be very unsatisfactory.

- Subject matter experts who serve as instructors need careful preparation and training to be successful video instructors. The most common shortcoming is a reluctance to use visuals or other presentation media on the air.

- The role and preparation of downlink coordinators is also critical to successful instruction. With up-front preparation, they can provide some of the interactivity that may be lacking with the on-screen instructor.

- The location and physical accommodations of the receive sites is an important factor for student acceptance of the technology.

Examples of Current Training Applications

- In the past four years, the Army Logistics Management College (ALMC) has trained 10,000 people in logistics information at 30 sites. Savings have been estimated at $10 million since 1985. ALMC set several operating principles to assure quality of instruction:

  - Since the instructor cannot see the remote learners with one-way video, no studio class was allowed, so that "empathy" would be with the remote learners.

  - Only seven sites per class, so that a high level of interaction could be maintained.

  - An extensive program of course revision and instructor training was used to maintain quality of instruction.

- Oklahoma State University broadcasts a broad range of courses and community service programs to communities throughout the state. Courses include remedial and community college-level subjects, in addition to procedural courses prepared by the Extension Service for remote farmers and ranchers. They also provide televised classes for rural high school students across the nation.

- IBM, Kodak, Penny's, and ComputerLand are among the companies using business television for employee training and information distribution. IBM plans to increase its usage to 225,000 class days per year by 1992. In addition, Federal Express has connected all employees for hourly updates on the status of its operation throughout the day and night. K-Mart and Apple Computer have also recently installed systems, but they are using compressed video, which is discussed in the next section.

- The Social Security Administration (SSA) uses a single uplink in Baltimore, Maryland to broadcast to 13 sites located in Regional Offices and Service Centers. The number of downlinks will be expanded to all regions. Programming ranges from 12 to 20 hours a month, and is a mix of public affairs broadcasts from the Commissioner and other administrators, and information and training programs sponsored by proponents in the organization. Videotapes of the live presentations are made, and can be distributed to locations that do not have downlinks.

Expectations for the Future

Broadcasting is a mature technology. Narrowcast television will remain as a primary delivery medium until digital technology matures.

Digital broadcasting (described in the next section) will allow signals to be carried over a variety of media and brought interactively to individual workstations. The advent of Integrated Switch Digital Networks (ISDN) will allow video, voice, and data to be delivered to workstations that are also used for other purposes, such as office automation tasks.

TWO-WAY DIGITAL (COMPRESSED) VIDEOTELECONFERENCING

What It Is

Two-way videoconferencing is possible with either analog or digital broadcast signals. An example of two-way analog video is a network television broadcast. Newsmakers at remote sites often appear on a screen, and talk with reporters in the studio. However, two-way analog video for training applications is not widespread because of high costs. The efforts that are underway to develop two-way video training technology that is both techically feasible and affordable are focused primarily on the use of digital signals and compression devices.

One of the benefits of digital signals is that they can be compressed to reduce transmission costs. Currently, an analog signal converted to a digital signal of 1's and 0's can be compressed up to 100 times, thus taking up 100 times less transmission space. These compressed signals can be transmitted over a number of media (microwave, satellite, fiber optics, etc.) at a significantly reduced rate.

Another promising aspect is that the device that converts signals from analog to digital is a modified personal computer. Thus, the converted video and audio signals can be manipulated and combined with other digital devices and information, depending on instructional requirements. Voice, audio, and data signals can be transmitted over single data lines, further reducing costs and providing more instructional flexibility.

A disadvantage at this stage of development of digital video for teleconferencing is in the full-motion capability of compressed digital signals. Particularly at lower transmission rates, moving images can appear "jerky" or break apart. Even at the higher rates, the visual picture does not yet have the full fidelity of broadcast-quality analog signals. In addition, hardware requirements for converting and compressing the signals at numerous sites are still significant cost factors.

Training Applications

At its current state of development, two-way digital vidoeconferencing is capable of providing a high-level of interactivity between instructor and students and between students at different sites. The instructor, working in either a studio or a live classroom, sees the students at other sites on separate monitors. Students at each site see either the instructor when he or she is speaking, or students at other sites when they speak.

Current pilot applications usually use two screens per site, one for the individual who is speaking, and another for graphics. Graphic

images such as spreadsheets, forms, or computerized planning documents from each site can be shown and manipulated at other sites.

The effects of the lack of full-motion fidelity in two-way digital video are being investigated in a number of training settings. At this stage, instructional presentations that require rapid or full-screen movement may need to be redesigned or distributed through other media such as videotape, or broadcast using one-way analog videoteleconferencing.

Considerations

While analog videoteleconferencing allows full-motion video and audio at sending and receiving sites, it is digital video teleconferencing with its compressed signals that is bringing two-way video and audio within the range of cost feasibility. As with any medium, there are several factors which must be considered in planning for its use:

- The degradation of motion quality when the signal is compressed may not be acceptable in some full-motion situations.
- Digital video uses equipment that is based on, and operates much like, a personal computer. The equipment can be rolled into a room and used without any special preparation, thus reducing costs for specially-trained broadcast personnel.
- All of the considerations that apply to analog video such as course selection, instructor preparation, and quality of the visual image at downlinks also apply to digital video.

Examples of Current Training Applications

Compressed video is a rapidly growing technology that is being investigated and implemented for use in training and education:

- The U.S. Navy is currently conducting a pilot project for distance training using compressed video in place of centralized shore-based instruction. The present pilot involves satellite transmission of compressed video, encoded for security reasons, to three sites in the southeastern United States. Full implementation calls for 100 sites capable of participation in a variety of courses, covering technical training, civilian personnel training, and human resources development training.
- The Air Force just completed installation of a pilot training program that links three sites in Hawaii, California, and Ohio.

- Boise State University is conducting a pilot program using a fiber optic network and compressed video to conduct courses from the university campus to community colleges and remote campus sites. Also, BSU will run a comparative test with full analog, one-way only video.

- Northern Virginia Community College and Oklahoma State University are also installing compressed video systems for use in distributed learning.

- As mentioned in the discussion on analog video, K-Mart and Apple Computer are among the companies installing digital video networks for field training of sales, maintenance, and management personnel.

Expectations for the Future

It seems clear that digital technology is important for the long term future. Techniques that allow digital signals to be compressed and transmitted over commonly available transmission media will mean that live, interactive video can be easily combined with text, graphics, and all other digitally-based media, and distributed on operational equipment. The FTS 2000 fiber optics system will likely be a major factor in the growth of digital delivery systems. Digital compressed videoteleconferencing will be improving in the next several years as compression algorithms are developed that allow near broadcast quality visual images and other new applications.

It seems likely that future organizations will find that their training needs are best met with both types of videoconferencing capability. The mature one-way analog video technology will be the distribution system of choice for training where full-motion fidelity is required. The growing capabilities of two-way digital video will be valuable for situations that require coordination with text, graphics, and other forms of computer-based information.

INTRODUCTION TO OPTICAL DISC TECHNOLOGY

In recent years, several technologies related to video have emerged, or are emerging. The development of optical storage using lasers has altered the way video can be used in training. One use of video in training is "interactive videodisc," or IVD. This term usually refers to training that is provided by an analog videodisc player combined with a personal computer. The videodisc can store 54,000 frames of still images or 30 minutes of full-motion video with dual

track audio. All information on the videodisc is randomly accessible, with a maximum search time of 3 seconds or less.

Since the term IVD was introduced, the Compact Disc, Read-only Memory (CD-ROM) disc has been developed. CD-ROM can also be combined with a personal computer to deliver interactive multimedia training. A videodisc is an 8 or 12-inch disc on which is recorded analog data. A CD-ROM is a 4.72 inch disc on which is recorded digital data. CD-ROMs store the equivalent of 270,000 pages of text, or 20,000 still images. Since CD-ROMs store audio and visual images in digital form, these images may be edited or changed at any time. This is not possible with an analog videodisc. Initially, CD-ROMs did not support full-motion video. However, two recent developments, Compact Disc-Interactive (CD-I) and Digital Video Interactive (DVI), now allow motion within the CD-ROM environment.

At present, DVI and CD-I are two competing technologies that offer full motion from optical storage of digital media. It is too early to determine which technology will prevail or whether both will coexist. DVI and CD-I accomplish a similar task, getting full motion video from optical storage, using a different approach. The hardware for DVI developed by Intel Corporation consists of a chip set to be added to an IBM compatible PC. Thus, DVI uses existing hardware configurations of PCs, CD-ROM drives and video displays. Cards containing the chip sets for compression and decompression of digital information are added to the PC to create DVI.

CD-I developed by Phillips Corporation is a separate hardware package based on a Motorola 68000 processor. There is no need to add a separate computer since the CD-I system already has a microprocessor built-in. CD-I systems are not compatible with DVI because they are built around different processors. They are similar only in terms of what they accomplish. Like DVI, CD-I stores video, audio and data in a digital format so it can be manipulated easily.

At present it is possible to store, retrieve and manipulate video, audio and data from optical storage devices. The primary advantage of optical discs is the large storage capacity when compared to magnetic disks. Given the large amount of information contained in a video image, increased storage capacity is vital. A standard floppy disk holds about a third of a megabyte, a high density disk holds about a megabyte and a half, and typical hard drives on PCs hold from 20-40 megabytes. An optical disc holds 650 megabytes. Therein lies the advantage. Another advantage is that CD-ROM, DVI and CD-I all use digital storage of data. So the data, including visual images, can be manipulated unlike the analog storage of videodiscs. Although the data originate from an optical device, since they are in a digital format they can be stored on a magnetic medium such as a floppy disk or hard drive if necessary.

These advances in optical storage will enhance the design and delivery of interactive training materials. The distinction between video-based and computer-based training will further blur as optical drives become common storage devices for personal computers. By combining the decision-making capabilities of computers, the vast storage capacity of optical discs and digital video display technology, means are available to support powerful training approaches.

Erasable optical drives have recently been developed and are being introduced. Unlike the current CD-ROM drives, erasable drives allow the developer to modify information stored on the discs. This facilitates developmental try-out and revision of training materials stored on optical discs.

CD-ROM (COMPACT DISC, READ-ONLY MEMORY)

What It Is

Compact disc technology is already popular as an audio storage and retrieval system. "CDs" are projected to replace long-play records within the next decade. The same sized disc can also be a mass-storage medium for text, graphics, photographic images, and audio. The information is reduced to digital form and stored on the disc. This storage capacity, combined with a computer, has high potential for training applications.

The information stored on the compact disc is "read" by a laser in a special CD player that is accessed by a disc drive or player controlled by the computer. At the present state of the technology, CD-ROM by itself can only provide still images. The technology necessary for motion will be more widely available within two years (see Digitial Video-Interactive and Compact Disc-Interactive).

Besides the wide variety of data that can be stored on a compact disc, the density of the CD medium is one of its most attractive features. The huge amount of information that can be stored on a single disc and displayed in text, video and audio modes provides users with a cost-effective reference database not previously available by magnetic storage methods. The storage capacity of a CD-ROM disc is described by Ives (1989b) as the equivalent of:

- 270,000 pages of text, or
- 20,000 pages of images scanned at 300x300 dpi, or
- 10,000 pages of 1/2 text and 1/2 graphics, or
- 1,500 floppy disks, or
- 1,200 microfiche cards, or
- 27 twenty-megabyte Winchester hard disks, or
- 10 standard 1/2" 9-track magnetic tapes, or
- one hour of full-motion, full-screen, full-color video.

Because data are stored on the CD-ROM disc in binary form, computer editing tools can be used to make changes, as desired. For example, an image can be reduced, enlarged, moved, or divided without sacrificing the original. This editing capability and ease of manipulation of the information provides a variety of options to CBT designers in creating courses, and to users in applying the information obtained.

Training Applications

The vast majority of CD-ROM applications developed to date have been for information storage rather than training. New databases and libraries are constantly being developed for users to buy outright, subscribe to, or license. Some of these discs function as stand-alone reference books; others are used in conjunction with other computer software, such as word processing programs; still others are integrated with interactive training programs.

Although the use of CD-ROM in educational applications is just beginning, this technology may be especially appropriate for discovery learning and for accommodating individual differences (Ives, 1989b). For example, CD-ROM:

- permits cross-referencing of related information in support of training;
- offers multiple learner pathways with extensive information on each; and
- provides access and navigation methods that include interfaces which permit rapid movement through stored material, and orienting guides or markers that indicate position within the stored information.

CD-ROM as a training technology may be of particular importance to the IRS because it seems likely that this technology will be used as a storage medium for operational work within the next few years. The vast amounts of data stored in other media today are a likely target for the mass storage capability of optical discs.

CD-ROM and other interactive technologies can provide the means to individualize education to a degree not possible before now. Students will be able to control their learning environment and the tools embedded in it. Ofiesh (1988), believes that CD-ROM is the solution to many problems in training design. He states that "We are now able to create interactive exercises that adapt themselves to different learners." Students "will even be able to select the media they feel are most conducive to their own learning." The challenge facing instructional technologists is to design improved curricula that fully utilize the interactive capability of the new technologies.

CD-ROM

CD-ROM provides an alternative to traditional linear formats because it permits learners to use an inquiry-based approach to the material. In other words, the learner can access data in a random fashion rather than being forced through in a previously determined order. The technology allows trainers to revise and redefine training designs, as well as reconfigure and update the database. Future developments will permit erasable, recordable and higher density storage. These features of CD-ROM will enable trainers and program designers to shift their focus "to the transfer of usable knowledge and skills to the learner" (Gery, 1989). However, extensive training will be required in the use of the technology before skill levels will be high enough to result in creative design approaches.

Recent developments in speech synthesis and voice recognition have added an audio dimension to courseware, made possible by CD-ROM. Previously, the only audio available in training was analog audio — the playback of prerecorded speech through tape recorders. Now, however, speech can be stored in digital form on some storage medium such as CD-ROM. This allows much greater storage and fidelity. Audio segments stored on CD-ROMs in such a manner are randomly accessible.

Audio can also be created by software rather than played back from prerecorded speech. Such synthetic speech has improved greatly in recent years so that it no longer resembles the older "computer voice". Synthesized speech allows the training developer to add audio to courseware by typing the audio passage from the keyboard when creating a lesson.

Voice recognition technology is not yet a mature technology, but much progress has been made in recent years. These advances will allow users to use their voices to interact with computers rather than having to type everything at a keyboard. This will be a big step toward achieving a smoother human/computer interface.

Considerations

Other points to consider when evaluating CD-ROM for training include:

- CD-ROM makes practical the use of new delivery media, such as digitized audio and video images, in the personal computer environment.
- CD-ROM is more economical per byte of data than other high-capability digital storage media.
- CD-ROM is cost-effective for those organizations already equipped with PCs.

- Present CD-ROM applications under current development are potentially compatible with the future high-frequency, "blue-light" laser technology that will permit higher density storage.

- A major obstacle to CD-ROM development is the lack of standards used to store and read information on a compact disc.

  At present, there are three standards: High Sierra, vs. Red Book vs. Yellow Book); the issues involve the file formats that will be read by various disc-drive standards and the compatibility of computers and drives.

- Quality standards must also be developed for CD-ROM. With both audio and images, higher quality requires greater storage space. Acceptable quality will vary with the application.

- A current limitation to the development of applications of CD-ROM is the slow rate at which images appear on the screen. This obstacle has resulted from the fact that the CD-ROM drive was originally designed to play music in a linear manner, not high-speed random access. This is a technical area that will need to be addressed as hardware modifications are made.

- CD-ROM is most beneficial and effective for the low-cost delivery of large amounts of static data to many sites.

- Because CD-ROM discs can be produced and manufactured cost-effectively at a fast rate, and mastering costs are dropping, CD-ROM is more cost-effective for mass distribution.

Examples of Current Training Applications

The use of CD-ROM in educational and training applications is still new and experimental. However, there is wide interest in applying CD-ROM technology to training.

- Apple Computer has just completed its first CD-ROM computer-based training program. Called the Apple CD-ROM Explorer (TM) disc, and developed with Apple Computer's HyperCard software, the program content covers how CD-ROM technology can be used as a new publishing medium for computers. Early program sections use sequences of graphics, animation, text and sound to present examples of potential users in various environments and different possible applications of CD-ROM. Later sections present sample applications from third-party vendors and music demonstrations of the CD-audio capability of Apple's CD-ROM drive.

- CD-ROM has been used primarily to house massive information databases including electronic encyclopedias, dictionaries, law

libraries, and research databases, such as ERIC and Dissertation Abstracts. CD-ROM allows quick acess with the use of a full text retrieval system, and as such provides volumes of organized information for use in training and work situations.

- Research conducted by Spectrum Interactive, Bedford, Massachusetts, indicates that still images can be just as effective as motion video for many training applications, including those teaching interpersonal skills. Because of its high density storage capability, CD-ROM may be a viable, low-cost training alternative to interactive videodisc systems, in spite of minor current technical limitations involving display speeds.

Expectations for the Future

"Industry experts predict that within a few years, CD-ROM drives will be standard equipment on most PCs, becoming as common as floppy diskettes and fixed drives" (Ives, 1989).

New applications of CD-ROM will continue to be developed in publishing and database product lines. Current CD-ROM products are primarily replacements for large-scale print, microform, and online information products; however, the CD-ROM technology enables them to be used at lower cost than other retrieval methods.

New CD-ROM products will incorporate an analysis of the tasks for which the user is retrieving information; this program shift to a utility/application function will provide the tools needed for using the data and dilute somewhat the current emphasis on the retrieval function (Paisley and Butler, 1987).

Thus, CD-ROM technology will allow the development of expert systems that will organize information into knowledge bases with a set of rules for manipulating the data. The accompanying programs will combine the functions of several computer utilities such that more control and information-finding power will rest with the user. However, the benefits of CD-ROM will not extend to most people unless sufficient training, learning, motivation and trial is provided and stimulated by schools, libraries, businesses and government information programs. Training will need to be provided on how to use CD-ROM systems themselves as well as on other topics by means of CD-ROM technology.

DVI (DIGITAL VIDEO INTERACTIVE)

What It Is

DVI, digital video-interactive, is an optical disc technology that enables the integration of full-motion video, high-resolution images, high-speed graphics, high-quality audio, and text. Video may be integrated with still images, graphics, audio and text on the disc in many combinations. Examples include the following:

- 72 minutes of full-motion video and audio;
- 20 minutes of motion video, with 7 hours of voice-over and 5000 high-resolution still images; or
- 2 hours of quarter-screen video with thousands of textures and 3D objects.

The most significant breakthrough offered by this technology is the ability to write, erase, and rewrite the information on the disc. Using proprietary DVI video and audio compression routines on one or more CD or magnetic drives, images and sounds are stored on the compact disc. At the PC workstation, the digital audio and video are decompressed and merged with the PC application as overlays. DVI can also be used for real-time animation, or for drawing on stored graphic images in a database. It can redraw these images at various screen coordinates and in different size configurations almost instantly.

Other features of the technology include multiple interactivity with mixed video and audio; texture and two- or-three dimensional objects; 360 degree panoramas; and integration with other digital media such as CD-ROM, hard disc, WORM (Write Once, Read Many) discs, and digitized live video.

Training Applications

There are many potential training applications for DVI technology, but few have been developed to date as the technology itself is still so new.

The video scenarios with graphic overlay and audio will permit learners to actively participate in their own training. For example, auto mechanics can interact with three dimensional models of complex systems; students can explore other countries and cultures in full circle panoramic views; and sales personnel can rearrange and upholster furniture on DVI systems.

Another type of training application of DVI is to use it concurrently with other applications to provide training and support for users of complex mainframe software systems. The compact disc can provide audio that is linked to an actual application by means of additional

software. For example, the software program monitors users' actions on the system and guides them in correct use through verbal prompts, permitting correct actions and alerting them to incorrect responses. This type of application eliminates the need to build complex simulations of the application software and facilitates updating of the training program.

Considerations

The following points should also be considered when evaluating DVI systems:

- The cost of the DVI system is high now during the initial development phase; however, when these costs come down, it may become less expensive than videodisc systems.
- DVI technology is well suited to the development of prototypes used as formative evaluation tools for interactive training programs. Such prototypes enable a low-cost test product to be developed first with critical attributes that can be evaluated. The test data is then used to modify and revise the program before production of the final version.

Examples of Current Training Applications

Because DVI technology is still very new, there have not been many instances of its use in actual training situations, although interest is high in its potential.

- Applied Optical Media Corp. developed a Truck Driver Safety training program for DuPont Safety Services, a venture of DuPont's Fabricated Products Department, using DVI technology. The concept behind this project was for drivers to be put onto roadways and to react to various obstacles and events that would, in turn, be affected by their reactions. This required manipulation of video images such that the perspective changed to correspond to the driver's position on the road at any given moment. Applied Optical Media received a license from GE to develop the program using DVI software. The program involved complex calculations of driver position, the continual changing of images from the database, and delivery of full-motion video. The program was developed successfully, with most production costs associated with software development.
- The Health Information Technology and Education Center (HITEC) at the University of Texas Health Science Center, Hou[illegible], Texas, used a DVI system to prototype an instruction[illegible]ideotape on the use of a complex piece of medical equ[illegible]ent. The objective was to prepare the prototype product

relatively quickly, formatively evaluate the prototype, and then develop the final product cost-effectively. The program design called for composite images, visual prompting, visual close-ups, effective visual sequences, and adequate "see-hear" compatibility. DVI technology was successfully employed to develop the prototype for purposes of formative evaluation. Success depended on access to the medical device, availability of video personnel and equipment, adequate project funds for video services, the exclusion of branching techniques in the prototype, and the use of linear motion sequences. Program developers recognized that the product would have been more effective if the system had incorporated branching, analysis of user responses, and digital motion video.

- Spectrum Interactive, Inc. developed a CD-ROM based system employing its Digital Audio-Video Encoding (DAVE) technology as part of a videodisc demonstration project for a client. The system was to be used as a desktop support system based on a PC. The objective was to reduce the cost by a factor of 10 in comparison to a traditional videodisc approach. The capability of the system has taken three forms: as an image-based reference guide for agents who operate from their desks and need a visual image and audio description of a product; as a desktop sales support system for salespeople who work face to face with customers and need both a presentation tool and a database of product and industry information; and as a training and support system for users of large complex mainframe software systems. The technology is capable of performing a range of training functions at the desktop, as it integrates digital video and audio with the power and accessibility of the personal computer.

Expectations for the Future

Instructional designers and system developers are only beginning to realize the potential of DVI technology. The decision of whether or not to use it in any given training application depends on several factors. One involves cost. At present, the cost of a DVI learning delivery station consisting of personal computer, DVI boards, CD-ROM player, and some form of interface is high; however, it is anticipated that costs will decrease significantly with the next two years. Production costs depend on the particular application and project requirements. Most costs of DVI system development will involve software development.

DVI technology will continue to be developed and expanded. Companies are beginning to build applications using DVI technology; however, at present, efforts are generally small scale and experimental.

COMPACT DISC INTERACTIVE (CD-I)

What It Is

Compact disc interactive or, CD-I, is a recently developed technology that allows full motion video from compact discs. Phillips developed this technology to bring interactive multimedia to the consumer market using a CD-ROM. CD-I can display still images, text, and moving images. The stand-alone CD-I players are built around the Motorola 68000 microprocessor and incorporate a CD-ROM drive. CD-I is a complete unit; no additional hardware is required.

CD-I is capable of providing 70 minutes of full-motion video from one compact disc. Without the compression routines of CD-I, a compact disc could provide less than four minutes of full-motion video at a frame rate of 15 per second. CD-I can store information other than full-motion video. For example, still images or audio could be stored on a disc. A 650 megabyte compact disc will hold 72 minutes of high quality audio, or 4,320 minutes, or 72 hours, of speech quality audio. Still photographs can be stored at the rate of 7,000 per compact disc for highest quality, and up to 56,000 usable images that, while not perfect, are acceptable. What CD-I provides is the integration of video, audio, text and data.

Training Applications

While CD-I was developed for the consumer market, there are some training applications that likely will emerge. An obvious training application is in the area of language training. This would take advantage of the audio storage capacity of CD-I. Still and moving images could be integrated with audio to enhance the language learning. CD-I could be used to provide training simulations to learners. All the necessary information for simulations including still and moving images, audio, overlaid text and data could be stored on the compact disc. The CD-I player then presents the simulation to the learner who interacts with it via a mouse. The use of CD-I for simulations seems particularly appropriate when realistic visual images are required. This is even more true when motion is essential to the success of the simulation.

Considerations

Compact disc-interactive provides an opportunity for rich training applications from compact discs although this was not the driving force behind its inception. CD-I is a consumer product built to provide information and entertainment to home users. That is the primary market. CD-I does, however, include features that make it suitable for training purposes. CD-I, like DVI, enables CD-ROMs to be useful for more than just information storage and retrieval. CD-I provides for interactive multimedia combining video, audio, text and

data. Thus CD-I can become an integrated training station capable of providing a wide range of courseware. Its strengths are in the storage and display of multimedia under learner control. Its weaknesses are its very limited installed base, lack of courseware, incompatibility with PCs, its need for all new hardware and its consumer orientation. It is much too early in the life of this technology to judge whether these limitations will be overcome or whether this technology will be replaced by competing technologies, e.g. DVI.

Examples of Current Training Applications

Compact disc-interactive is still too recent a technology to have examples of training applications. The lack of applications is a result of the newness of the technology rather than some underlying weakness or rejection of the technology.

Expectations for the Future

It is reasonable to expect that video and computer technology will continue to merge and that optical storage will become more common. There is little doubt that optical storage will increase in importance because of its vast capacity. CD-I can allow a rich environment for training. some form of digital storage of video, audio, data and text will very likely be a prime candidate for the training delivery system of choice in the near future. Currently CD-I an DVI are competing technologies. Whether CD-I will dominate DVI or DVI will dominate CD-I like VHS has dominated Betamax remains to be seen. It is also possible that both technologies will co-exist like IBM PCs and Apple Macintoshes.

Much future training will be delivered at the workstation through some interactive technology. CBT will evolve to incorporate more than text and simple graphics. The integration of video and computers is very likely. This will require greater storage capacity. All of this taken together points to a digital technology like CD-I or DVI as a delivery system.

INTERACTIVE VIDEODISC

What It Is

Interactive videodisc (IVD) is an optical disc technology that combines full-motion, TV quality video, audio, and graphics on a laser optical disc with the interactivity of computer-based instruction. The

videodisc, read by a laser, is controlled by the computer, which makes possible access to any point on the videodisc in fractions of a second. Students use the computer keyboard, touchscreen, or light-pen to interact with the program.

The videodisc contains analog recorded data, with a maximum stroage of 54,000 frames of still images or 30 minutes of full-motion video with dual track audio.

IVD provides multiple branching capability, immediate feedback, a one-on-one student-instructor ratio, and interactivity via three senses (sight, hearing, touch). IVD can permit a high degree of learner control for self-paced learning, remediation or rapid advancement in response to student input, and a realistic environment by means of simulations of real equipment, procedures and operations.

Training Applications

Interactive videodisc "presents information in a format that Americans respond to almost instinctively: television" (Christensen, 1988). A 1984 IBM study showed "interactive video to be three times more effective at teaching than an instructor." IVD is "capable of complex performance simulations that often can take the place of hands-on practice and testing" and "...makes possible truly individualized instruction" (Ross, 1988).

The use of full-motion video and audio makes this technology an effective enhancement to other forms of computer-based training. IVD is effective in many technical training applications, such as hands-on skills training, as it is well-suited to the teaching of procedures, operations, equipment maintenance such as automated equipment troubleshooting and repair, administrative tasks, and interpersonal skills. The technology can provide realistic simulations that mirror actual problem situations encountered on the job.

Considerations

Points to consider about the uses of interactive videodisc are:

- It operates with a wide range of hardware systems and lends itself to the modular approach of component replacement and enhancement; however, there is still some hardware and software incompatibility between systems.

- It permits the combination of full-motion video, audio and graphics in real-time. The two audio tracks on the videodisc can be used for presentation, remediation, advanced level or supplemental instruction, or presentation in a second language;

however, the real-time limitation may be a constraint in some applications and program designs.

- It is expensive in terms of up-front costs for hardware and for mastering and producing discs; however, in the long term, significant cost savings can be realized if sufficient numbers of trainees use the program and if the content does not need frequent updating.

- It typically involves high development costs for customized courseware; generic, off-the-shelf courseware costs are much less, but may not meet the specific training requirements of a given situation or training need.

- It provides consistent instruction in a standardized format with a high degree of learner control; as with all forms of self-instruction, repeatedly shows a significant time savings over similar training conducted in the classroom.

Examples of Current Training Applications

IVD is being used by a growing number of large corporations, businesses, utilities, factory operations, government agencies and the military to train a wide variety of skills.

- Federal Express uses interactive video to train mechanics to troubleshoot and repair Federal's aircraft fleet. The Memphis-based company has established training workstations at 12 locations besides Memphis, and within 10 years, expects to have 46 facilities in the U.S., plus several more overseas. Federal Express also plans to increase the number of its interactive video course offerings.

- Ford Motor Co. trains workers via interactive video on a computerized numerical controller used to run automated machine processes, such as the lathing of transmission parts. Assembly line personnel train on the 30-hour program off shift and at their own speed. Ford Motor Co. trainers say that the IVD simulation not only imparts knowledge but also instills confidence in the workers; trainees can make mistakes without ruining critical expensive equipment. The program is paying for itself through decreased downtime and training costs (Holste, 1988).

- Massachusetts Mutual Life Insurance Co., Springfield, Massachusetts, uses interactive video to train more than 4000 agents nationwide. A videotape pilot program in 1985 has grown to 18 interactive videodisc programs, covering such topics as financial design, recruiting and coaching skills, business designs and selling. The selling skills program alone is a

complex, 8-12 hour course. Massachusetts Mutual combines the interactive videodisc programming with videotape, which is now used primarily as a live training aid. The director of field development reports a decrease in training time of more than 30%; one trainer stated that the program saves him 10 hours per week. In addition, the increase in first-year commissions by trained agents is measurable, and according to Curtis, that "makes our case for interactive video" (Holste, 1988).

- Xerox Co. uses interactive video extensively for training. Its 60 training locations in the U.S. use 400 interactive video units, and more have been installed in several European countries. The Xerox technical training program development manager states that the company uses interactive video for generic training; for example, paper-feeder servicing. There are 10 videodiscs on exploring computer systems and 14 discs on reprographics systems, as well as programs on soldering techniques, manufacturing and customer relations (Holste, 1988).

Expectations for the Future

Interactive videodiscs seem to be gaining in popularity as a large number of businesses and government agencies have or are developing systems for training. Computer-based, interactive training systems currently account for 30% of corporate training expenditures; while interactive video systems now take a 2% portion of this, it is expected that they will account for 8% of the rapidly growing training market by 1992 (Ross, 1988).

Cost remains the major obstacle to widespread use of interactive video training systems.

Poor program design is another obstacle to continuing use of the technology. Design changes are expensive, and may weaken the commitment of top management to long-term funding of programs. However, since many training departments cannot or do not want to produce programs in-house, the community of providers is growing, and includes hardware and software providers as well as courseware developers. In addition, as hardware firms standardize their products, and as more courseware for interactive video systems is produced, the technology is becoming more affordable.

As new technologies are developed and applied to training, interactive videodisc may eventually be supplanted or significantly modified. With the development of digitized CD-ROM storage capability and digitized video, what is now known as IVD may merge into standard CBT applications. The same hardware could then be used to present all types of computer training.

However, IVD is expected to realize significant growth at least throughout the next decade. This will depend, in large part, on the development of equipment standards to ensure compatibility between systems, and on the production of more generic courseware.

TRENDS IN TECHNOLOGY — SOME CONCLUSIONS

Recent years have brought many new developments and enhancements to technology that will influence how training is done in the near future. There is much promise in these powerful electronic tools, both for improving the quality of training and in holding down costs. However, there are also possible pitfalls associated with this technology, or rather, in our use of it. There are two very different approaches training may take to the use of technology: repackaging and rethinking.

In repackaging, older ways and forms of training are simply repackaged to fit into the new technology. As Marshall McLuhan noted, "We live in the rear-view mirror"; that is, we often use new technologies to do exactly what we did yesterday, only just a little faster (McLuhan, 1969). Much computer-based training reflects this repackaging phenomenon.

Such was the case with instructional television; television cameras were focused on lecturers making presentations to classes. Older programmed texts or flash cards were programmed into a computer to form CBT. In some cases, film strips were stamped into videodiscs. All of these represent poor uses of a newer technology caused by mere repackaging of training material from an older technology.

Instructional television is more than a recording of a live lecture; CBT is more than automated programmed instruction or electronic flash cards; interactive video is more than a way to deliver film strips. This is akin to a farmer hitching his new tractor up behind his mule to plow his fields. We will not harness the power and cost-effectiveness of the new technology to meet all the expanding needs for training with such outdated approaches.

Getting the benefit from the technologies that were described in this section will require the second approach to the use of technology: rethinking. In this approach, the technologies are examined in terms of their capability to provide training at maximum effectiveness and at minimum cost. This requires a matching of the capabilities of technology with educational theories and principles to design

appropriate uses of the technology. We should ask, "What can be done with this technology to facilitate training?"

To answer this question, we must explore what is known about how people learn and how they can be instructed. Then, this information must be juxtaposed over the capabilities of the various technologies to create training applications. In this manner, technology is more likely to be used appropriately to support training for widely dispersed audiences in the most cost-effective manner.

The technologies mentioned in this chapter will facilitate the building of skills and knowledge inventories of present and incoming employees. These technologies will also help us to be more responsive to individual needs. The heavy emphasis on lock-step classroom training can be greatly modified and allow for the delivery of training to individuals according to their work assignments, the instructional content, the instructional strategies, and the Service's local technical needs.

The following section describes some recent developments in educational theory and methods that have implications for the use of technology in training. These developments in educational theory and methods define how the technology should be used for training.

EDUCATIONAL THEORIES AND METHODOLOGIES

The instructional technology of the future is more than the sophisticated hardware systems that permit information storage and retrieval, access and presentation. It is also the complex instructional design strategies and methodologies that provide the structures within which users can access and process information.

The power of the delivery and storage technologies is that they can unleash the instructional designer from the linear processes of the past. Ofiesh (1989) notes that using these tools will require improved curricula that fully utilize the interactive capability of the new tools. The only way that technology can help the nation meet the challenges of the 21st century is for training to be available on demand, cost-effective, and used in the ways that measurably increase human productivity.

This enormous challenge requires able learning specialists who can probe the instructional process and create the types of "true dialogue with experts" that can enhance human capability and creativity while containing training delivery costs (Ofiesh, 1989). The theories and methods presented in this section provide some guidelines for this new instructional design process.

Adult Learning Principles

There is a growing body of literature on teaching adult learners that can be used to guide the specification of a training system for adults. Knowles (1978, 1987), Knox (1986), Cross (1976, 1981) and others have summarized information about how adults learn and have identified characteristics for effective instruction of adults. A principle that underlies much of this work is that adults are different from children in how they learn, and therefore the process used for teaching adults should differ from the process used for teaching children (Knowles, 1978).

When compared to children, adult learners have a greater need to know why they are being taught some content; they have a greater desire for participation and control over the learning; they have a greater repository of experience to which the new learning can be related; and they wish to set their own pace for learning. Adult learners have a greater need for feedback on their learning; they are more task oriented; they bring greater diversity to the learning situations; and they prefer a variety of instructional methods. Finally, they like active rather than passive learning experiences, and they like to determine the place and time of learning (Cross, 1982; Knowles, 1984). Each of these characteristics has an implication for how adults should be trained.

Certainly the evidence on adults as learners argues against the exclusive use of the traditional classroom mode of training. Jack E. Bowsher, former Director of Education at IBM, makes the point that in college, 50% of the learning typically takes place in the library or dormitory as students take more responsibility for learning. He questions why we should then revert to the "third-grade model" for training adults, i.e. lecture-based classroom training (Bowsher, 1989).

Knowles and Cross have developed principles for teaching adults based on characteristics of adult learners. Frequently cited principles include selection of objectives in light of the learners' need, a variety of options built into the training program, frequent feedback on learners' progress, task oriented content, ability to adapt to learners' self-paced training, and frequent interaction.

Whereas most of these principles are impossible to implement in traditional classroom-based training programs, technology-based approaches to training can incorporate these principles. Learners completing a CBT lesson can work at their preferred pace and sequence the training in different ways. They can determine the amount and kind of practice they need, as well as how many examples they wish to see. Technology can shift the focus in training from the instructor to the learner. This shift allows the training system to implement and make concrete many of the principles of adult learning.

Learner Control

Clearly of limited importance in traditional instructor-led classroom training, the idea of learner control can now be exploited to allow adult management of key aspects of their own learning. In a learner-control approach to instruction, some or all of the decisions about what to learn and how to go about learning it are made by learners rather than by instructors. The decisions can involve what objectives to work on, how to sequence the lesson, what the pace of the instruction should be, how many and what kind of examples to see, how much practice to get, what terms to define, and what concepts to illustrate.

In addition to selecting the objectives to study, one learner might choose to see several examples of a concept first, then see the underlying rule, while another learner might decide to first see the underlying rule, and then the examples. The intent in learner-controlled instruction is to improve the instruction by accommodating individual differences and allowing the learners to play a more active role in their learning.

It is tempting to form a dichotomy between instruction controlled by the learner and instruction controlled totally by the teacher or instructor. Some have argued for total learner control of instruction,

but research indicates this is unwise (Steinberg, 1977; Merrill, 1980; Jonassen and Hannum, 1987). It is more productive to view learner control along a continuum from low control or control of a few aspects of a lesson, to high control or control of many aspects of a lesson.

Studies have shown that learners make good choices about the pace of the instruction, the amount of practice, and whether to see an overview (Wittrock, 1979; Campanizzi, 1979). Students with high levels of prior knowledge make good choices about the instructional strategy; students with low prior knowledge do not (Hansen, 1981). In general, students make poor choices about sequencing topics, whether to have any practice, and the difficulty level of the practice (Ross and Rakow, 1981; Rubicam and Oliver, 1985; Carrier, Newell and Lange, 1982). A number of studies have shown that learner control can be more effective if the learners are given some guidance about how to use learner control options (Johansen and Tennysen, 1983; Tennyson and Buttrey, 1980).

The training technologies cited in this report are capable of providing more learner control of instruction than has been possible previously. Some training developers use this technology to provide total learner control, yet research and experience indicate that learner control of everything is no better than learner control of nothing. By using information from research on learner control, training specialists can create powerful new individualized instructional programs.

Learner control with guidance could be built into a hypertext system so that learners could move about freely but could get suggestions when they wished. A CBT lesson on determining whether an organization qualifies for tax exempt status could allow the learners to determine when to refer to regulations, how many examples to see, when to look at underlying principles, or when to get a more elaborate explanation. This way, the training could be made more useful to learners with varying amounts of background knowledge. All learners would not be forced through identical training but could control certain aspects of the lesson so that the training better "fitted" their needs.

Cognitive Task Analysis

As work becomes more complex in an increasingly information-based society, the process of analyzing what workers do (and in turn deciding what needs to be trained) becomes more difficult and requires new approaches. Task analysis, the process of breaking down or decomposing workers' tasks into simpler subtasks (Gardner, 1985), has been traditionally applied to directly observable tasks such as those performed by employees in a manufacturing firm. In this case, an observer could watch incumbents performing a task and record exactly what they did in a step-by-step fashion. More and

more tasks, however, are not directly observable, such as many of the tasks performed by employees in knowledge industries. These tasks might involve such things as analyzing data, drawing conclusions, or making decisions. The "work" involved in these tasks takes place internally in the employees' minds; thus, it is not directly observable.

Cognitive task analysis is a way to analyze the steps a person goes through when performing a task that is primarily internal. Cognitive task analysis seeks to uncover the mental aspects of task performance. The emphasis in cognitive task analysis is not on human behavior, as in traditional task analysis, but rather on human thought processes. Cognitive task analysis breaks down "mental work," not physical work. It attempts to determine what knowledge an expert uses when solving a problem and how he/she uses this knowledge.

Developments in cognitive task analysis are important for training since so much of current and future training will be for knowledge workers, rather than production line workers. In order to get novice employees to perform more like expert employees, one must understand how expert employees perform. Cognitive task analysis provides these insights. Cognitive task analysis can also be used to aid in the understanding of the cognitive strategies employees use in problem-solving tasks (Foshay, 1987).

Information from cognitive task analysis can be used to define the training content since it identifies what information an employee should know and how this should be used in performing some aspect of his/her job. For example, in developing embedded training to teach a particular applications program, cognitive task analysis would identify the information a skilled user should possess; this would then be embedded in the application.

Expert/Novice Distinctions

Using the power of new technology it will be possible to expose employees to the ways in which experts think, thus teaching them strategies that in the past have taken years of experience to develop. We all recognize that, in most endeavors, from playing chess and working crossword puzzles to making medical diagnoses and troubleshooting electronic devices, some people are much more proficient than others. Certainly, there are striking differences between the performances of experts and novices on a given task or problem.

Recently, researchers have begun to discover some of the differences that exist between experts and typical performers. Interestingly, experts are distinguished not only by the amount of information they possess but also by how they organize or structure their knowledge (Schoenfeld and Herrman, 1982) and how they select and use knowledge to solve a problem (Johnson, 1987). Experts spend more time

than novices trying to find a way to represent a problem before attempting to find a solution to it (Chi, Feltovich and Glaser, 1981; Larkin, 1979). When presented with problems, experts look for patterns, underlying structures or principles, and similarities to known problems. They try to reconfigure the problem or represent it in a different way that allows them to solve it more easily.

Since training is a process of developing expertise, training developers can use the work on how experts function to help them define the content for training. This implies that training would include more than just knowledge or information about a topic. Training would include how the information is organized, strategies for its use, examples of how experts use the information, and practice in representing problems in ways that facilitate solutions. The study of what experts know and how they function compared to what novices know and how they function can guide how training is developed.

Information about what experts know and how they work has been made more important by newer technology. For example, when human expertise can be captured and represented in a computer program, as is the case with expert systems, then the performance of typical or novice workers can be enhanced; less highly trained or experienced people can then perform at levels previously attained only by experts.

Tutorial CBT programs can demonstrate how an expert would solve a particular problem and then explain the reasoning behind it. In this way, employees are exposed to the critical thinking processes of recognized experts. Moreover, lessons, courses, and entire curricula can be designed to represent, teach, and practice this higher level of thinking.

Hypermedia can be designed in a manner that overtly reflects the knowledge structure of the expert (Jonassen, 1989). In such a design, learners are able to browse through networks of interrelated concepts, to see important associations and patterns, and to try all sorts of different applications and adaptations of the knowledge to new situations.

Metacognition

Metacognition refers to one's knowledge or thought processes about his/her own cognition. It is our own thought about our thinking, our awareness and regulation of our thought processes. Learners use their metacognitive knowledge when they approach a new learning task by determining what they already know about the learning task, determining what aspects of the task to attend to, selecting a strategy to use in order to learn the task, and monitoring their progress while learning the new task. Schmitt and Newby (1986) indicate that metacognition involves two major components: 1) knowledge of

one's cognitive resources and task requirements and 2) regulation of mental processes involving planning, monitoring and revising. Forrest-Pressley and Waller (1984) distinguish between cognition, which is the actual process used by a learner such as memorizing, and metacognition, which is the learners awareness of and control of cognition. Cognitive psychologists have recognized the importance of metacognition in learning and are beginning to have a better understanding of it. Repeated studies have demonstrated the efficacy of teaching learners how to use metacognitive knowledge to improve their learning (Haller, Child, and Walberg, 1988).

Usually training programs focus on teaching specific knowledge and skills to learners without any regard for their metacognition. An alternative is to teach metacognition in addition to specific topics and thereby improve the learners' abilities to learn. Metacognition training is seen by some to be a powerful training tool since it improves a learners' ability to carry on his or her learning. If learners could recognize and optimize their strategies for learning new information and procedures, then not only would they be able to train more efficiently, but they would undoubtedly improve their job performance as well.

Training developers could use information about metacognition to enhance training materials by designing materials in ways to correspond to learners' mental processing (Gagne, 1985). These strategies may include the teaching of metacognition among the objectives (Tennyson and Rasch, 1988) and embedding strategies in the training materials that promote more metacognitive activity (Jonassen, 1984). Through such procedures, learners become better able to continue their own learning in a more efficient fashion, and as a result, they can operate more independently and with more initiative on the job.

Transfer of Training

The major, if not only, purpose for training in most organizations is to enhance job performance. This implies that what is learned during the training is transferred to the job. Transfer of training means that what was learned in one situation, e.g. a classroom, is applied in another situation, e.g. the job. Transfer of training also means that the learner can apply a particular piece of information or a specific formula he/she learned in one situation, or with one example, to another situation or example. It is not that training is good *ipso facto*, but rather that training is good to the extent that knowledge and skills gained during training transfer back to the job. Thus, planning for transfer of the training is a consideration in designing and delivering training. Otherwise, all training would be in isolation, and a person's job performance would not be altered by training.

There has been considerable work aimed at understanding what facilitates transfer of training (Patel and Cranton, 1983; Chen et al., 1984). Learners are better able to transfer intellectual skills, such as using concepts and rules and problem solving, when the initial instruction is followed by a variety of practice problems (Gagne, 1985). This provides learners with an opportunity to practice transferring what was learned in one situation to a different situation.

Transfer can be either vertical, in which a lower level skill is transferred to a higher level skill, or horizontal, in which a skill is transferred to a similar situation. Another way to facilitate transfer in concept learning is to use a variety of examples of the concept being taught (Merrill and Tennyson, 1977). The examples should vary all attributes of the concept that are irrelevant while holding constant the defining attributes.

Another approach to transfer is that of delayed practice (Ausubel et al., 1978). Practice exercises presented at a point in time after the initial learning have been shown to facilitate the retention and transfer of previously acquired information. Some studies have demonstrated positive transfer effects from having the learners elaborate the new information (Larson et al, 1985). Studies have also shown that instructing learners in metacognitive activities can facilitate transfer.

With the capabilities of the new technology, individualized activities such as exploring a variety of examples, working immediate and delayed practice problems, and using strategies that develop metacognition can be built into training materials.

Human-Computer Interface

As employees perform more of their work and complete more of their training on computers, the interface between people and computers takes on even more importance. Evidence has shown that improvements in work and training occur when the interface is carefully designed, and become impeded when the interface is not carefully designed. There is a body of evidence about the design of the human-computer interface that can be used to guide the development of training materials that are delivered via computer. Appropriate design of the human-computer interface ensures more efficient interaction of the learner with the training materials.

There are several principles that can be used to facilitate human-computer interaction. The design and layout of the computer screen itself affects interaction and learning (Kerr, 1986; Grabinger, 1985). The screen should be laid out in a consistent fashion using a grid system, with considerable "white space", using functional areas and borders (Faiola and DeBloois, 1988; Heines, 1984; Lillie, Hannum and Stuck, 1989). Graphic images can be used to provide cues (Jay,

1983), to organize information (Moore and Radance, 1983), or to guide the learners through a lesson (Benson, 1985). Prompts indicating the type of response, as well as how and when it should be made, should be included when the learner/user must make a response (Jonassen and Hannum, 1987). The software should also allow for editing of responses if the user/learner makes a mistake or changes his or her mind about a response.

Concern with the design of the human-computer interface can improve computer-based training because it allows the learner to concentrate on the content of the training rather than on the manipulation of the hardware or software. Since the very heart of much of the new training technology is its ability to interact with learners, information about the interface must be incorporated into the design of software to take advantage of the capabilities of the technology.

Instructional Sequence

There are different approaches to sequencing training based on the kinds of training outcomes sought. There are different categories or types of training outcomes (Gagne, 1985). A different instructional sequence is necessary for training when the outcome is an intellectual skill such as problem solving than when the outcome is information. This sequencing is particularly important when designing technology-based instruction for individuals because instructors and/or coaches may not always be present to aid the teaching process. The lessons must be structured so carefully as to be able to "stand alone," i.e., to teach the objective without any help from instructors.

Research on learning indicates that in order to acquire a specific intellectual skill outcome, the learner must first have mastered the skills that are prerequisite to that specific outcome (Gagne, 1985). For example, before someone can learn to substitute a pronoun for a proper noun, he or she must be able to identify nouns, determine if they are singular or plural, determine the gender of the noun, etc. Gagne, Briggs and Wager (1988) suggest deriving a learning hierarchy for intellectual skills that identifies the prerequisite skills for each final skill to be learned.

A learning hierarchy is a representation of the final skill to be learned and all the essential prerequisites for that skill. Learners proceed through the instruction from the lower level skills to the higher level skills in the hierarchy. The evidence supporting the existence of learning hierarchies dates back 27 years (Gagne, 1962). Since that time, considerable research has indicated that intellectual skills are organized in a hierarchical fashion, and that mastery of higher level skills is dependent on prior mastery of lower level skills. Since learners don't master higher level skills until they have mastered the specific lower level prerequisite skills, effective

instruction of intellectual skills requires that the instructional sequence must be from specific lower level skills to higher level skills. When the outcome of training is the acquisition of information, a different instructional sequence is necessary (Reigeluth and Stein, 1983). Information exists within our cognitive structures, not as isolated facts, but rather in an organized fashion. A specific piece of information exists within a web type structure of related information. Information within these structures seems to be organized in a hierarchical fashion with the more inclusive, general ideas at the top. When learning new information, people begin by determining where the new information "fits" within their existing cognitive structure. The instruction can be facilitated by beginning with the "big picture", or main idea, to which the new information is related, and progressing to more specific information (Ausubel et al., 1978; Reigeluth, 1983). This work on the learning of information has several implications for sequencing of instruction.

The sequence for teaching information should be from general to specific. In this general to specific sequence, Ausubel suggests that the instruction distinguish the specific information from the more general, previously acquired information in a progressive manner, i.e. pointing out more specific differences as the instruction progresses. The preferred sequence is from the more general or inclusive idea to the specific information (Ausubel et al., 1978). The presentation of specific information should be preceded by the presentation of an organizer (Mayer, 1979; Hawk and Jonassen, 1985). The sequence of presentation can begin by going from general to specific, then jumping back to the general, then to another specific, thus showing the whole, one part, the whole again, and then another part.

Schema Theory/Mental Models

During the past few decades, as psychologists turned away from the study of human behavior to the study of human cognition, they placed much attention on how a person organized and stored information coming from the environment. Piaget (1954) indicated that individuals seek to make sense of their environment by organizing and grouping related information into categories represented by internal schemata. Schemata are the internal representations of stimuli in an organized fashion; they are categories or concepts. Through the continual interaction of a person with his or her environment, his or her schemata influence what is learned and what is modified in the process. Existing schemata influence new learning because we seek to relate new information to previously learned information. Information that seems close to fitting an existing schemata is "rounded off" and placed in that schema. Likewise, existing schemata are altered through learning when the new information does not fit an existing schema.

Several theories incorporate schemata as a main aspect. Rumelhart and Norman (1978) use the concept of a schema to explain three types of learning: 1) accretion - encoding new information into existing schemata, 2) restructuring - creating new schemata, and 3) tuning - refining existing schemata. Accretion is similar to Piaget's concept of assimilation in which new information is brought into existing schema. During accretion, new information is added to memory without changing the organization of knowledge in memory (Schuell, 1986). Restructuring and tuning are similar to Piaget's concept of accommodation in which an existing schema is changed in order to incorporate new information.

Cognitive psychologists have distinguished between two types of knowledge acquired through instruction. Declarative knowledge is "knowing that" and procedural knowledge is "knowing how to." Schemata exist for both forms of knowledge (Gagne and Dick, 1981). This distinction between these two types of knowledge is important because studies have shown that different training methods are necessary to teach declarative and procedural knowledge (Reiser and Gagne, 1983). How a learner represents the instructional content impacts his or her learning. That is, what he or she stores in his or her cognitive structure influences his or her performance capability and his or her subsequent learning.

Schema theory provides an insight into how training materials should be organized and presented. When new information to be acquired is an elaboration or extension of an existing schema, the instruction must first activate the existing schema, perhaps through an advance organizer, then show the relationship between the new information and the schema, perhaps through analogies. When the new information to be acquired will require restructuring, a new schema must be formed and distinguished from existing schemata through comparison and contrast (Ausubel et al., 1978). Schemata influence what a learner is able to recall and allows learners to fill gaps in their knowledge (Gagne and Dick, 1983). Developing more sophisticated schemata in learners enhances their future learning. The versatility and interactivity of the new training technologies provide instructional designers the potential for building these new mental models that will aid learners in more complex job tasks.

ORGANIZATIONAL ISSUES

In general, the trend in information-based organizations like the IRS is toward a melding of operational and training activities, and a much more active role for training in organizational design and development. As noted in Chapter 1, training is being identified as the one factor that can lessen the effects of the dual forces of technology explosion in the workplace and a severely constrained labor pool.

In addition, a career-long program of professional development is seen as one of the major ways that Federal agencies can compete with the private sector for scarce, highly-skilled workers (Volker, 1989). That type of integrated program must be managed and coordinated across functional lines, from a central position in the organization. Training organizations are assuming that role in both the public and private sectors.

The specific organizational issues involved are discussed below.

Interconnections Between Work, Information, and Training

As Applegate, Cash, and Mills (1988) note, organizations have tended to adopt technology first, then figure out how to cope with the organizational and training implications. More powerful technologies are increasingly entwined with an organization's critical processes. Training and operational work can no longer be considered as separate processes.

Drucker (1987) has noted the organizational implications of information flow. Traditional organizations basically rest on command authority, with the flow of information from the top down. Information-based organizations rest on responsibility. Information flow is circular, bottom up, then down again. This difference is the most pronounced in information-based organizations. The relationships between work, training, management, and information are undergoing significant change.

In addition, information systems are assuming many of the communication, coordination, and control functions that had been the role of middle managers. Bleeker (1987) reports that one large multi-national corporation reorganized around information flow, and deleted 12 levels of unnecessary management in the process. These trends are consistent with systems approaches to organizations that identify "value added" by organizational level and the information flow and working relationships that are necessary for efficient and effective organizations (Jaques, 1976; Miller, 1978; D. Smith, pers. comm., December 11, 1988).

The interconnections between operational work, information, and training are important issues for the IRS because of the many separate information systems and databases that are being developed. The relationships among these systems will be important to training analysis and design, particularly as workers are trained and retrained in response to new job requirements. The computer-human interface is one important consideration, but the human-human interface across these organizational units is equally, if not more, important.

Training and Organizational Development

In many organizations, training is already becoming the catalyst of organizational change. A job/task analysis for training on already-installed equipment is often the first time that questions of input and output have been asked. Training analysis questions like "what is the product of this task?" and "where does it go inside and outside the organization?" are often identifying the overlaps and disconnects between jobs and functions (Bleeker, 1987).

The role of Federal trainer as organizational development specialist is an idea that is gaining popularity in many agencies (Newell, 1988). Part of this requirement can probably be traced to budget cuts and the ongoing effects of automation. Fewer people to do more work has required managers to evaluate their workplace and workforce to find ways to reorganize for more efficiency. Consultants from the training functions are being asked to accept more of that responsibility and to work with other human resource specialists to develop integrated approaches.

Newell (1988) also notes that this requirement will present the government training community with its own massive training task. In addition to the new requirements for instructional design, trainers will have to gain more expertise in the processes and concepts of organizational analysis and design. One outcome of this increased role for training is that the profession will need to be upgraded in government classification standards to parallel the growing importance of training and to attract and retain top talent.

The force behind this trend is that there needs to be an organizational unit that can maintain a generalist view of the entire organization, its people and its work processes. IBM is typical of the organizations that are discovering that the training function is central to organizational processes, and the most effective unit to provide that total view (Galagan, 1989).

Training specialists have traditionally provided a broad view of organizational performance through conduct of performance analyses. Before decisions to provide training are made, performance analyses are done to identify the performance problem and determine the probable causes. Not all problems with the performance of

employees can be solved by training. Some problems are solved by a redesign of the job, some by more careful supervision, some by new tools such as expert systems, some by job aids, some by personnel reassignment, some by increasing incentives, some by providing more feedback to employees, and some by redesigning forms or workflow patterns.

When the cause of the inadequate performance is a lack of employees' knowledge or skill, then training on that knowledge or skill is probably the best approach to solving the problem. If the problem is caused by poor or inadequate supervision, lack of appropriate tools or equipment, inadequately designed software, or unreasonable working conditions or workloads, then additional training is likely a waste of time and resources.

Through performance analysis, then, training specialists are identifying problems and their causes within the total organizational environment, and looking to multiple sources, including training, for the best solutions to enhance organizational effectiveness.

The Position of Training in the Organization

Another organizational trend is that training will be moving into more prominent roles in terms of function and level of management. Newell (1988) projects that Federal training offices will be elevated in the organization, perhaps moved up and out of the personnel department as their significance becomes more widely accepted. If so, this will be consistent with industrial trends like IBM's restructuring that moved the head of training into a position parallel to the vice presidents for operations and marketing. As Galagan (1989) notes, making education the supporting base of the management system triangle means that it is part of every operating plan. In IBM's 390,000-employee organization, 7,000 education specialists maintain a total system of employee development that includes tracking employees through 84 separate job categories, from entry-level to upper management.

For the IRS, the 1990's are going to be the time when the forces of demographics and technology come together. New, highly skilled employees will be scarce, and the workplace will continue to evolve into the full automation predicted for the 21st century. Training for every category of employee in each function is going to be critical.

The training technologies that may provide the solution to some of these problems are going to require the kinds of scarce instructional designer expertise that must be developed quickly if these tools are to reach their capability. This capability must serve the entire Service, and will need to be built and maintained centrally for integrated course development across functions.

The need for a career-long professional development program has been discussed throughout this report. This capability will require integrating professional, management and executive training, and creating a development management system.

Additionally, as operational and training technologies meld into a single system, training and operations must work together to maximize the potential of these tools.

SUMMARY

Chapters 3 and 4 have described the trends that must be considered in designing an IRS training system for the year 2000. Trends in the workplace, workforce, training technology, educational theory, and organizational structure are all pointing to a time of continuing and accelerating change. Meeting these changes will be an enormous challenge — one that will require a commensurate change on the part of the entire organization in terms of training philosophy, delivery systems, and methods.

Chapter 5 FUTURE IRS TRAINING

VIEWS FROM THE LEESBURG WORKSHOP ON IRS TRAINING 2000

One of the key inputs to this project was a workshop for IRS training and functional managers from the National Office and the field, held at Leesburg, Virginia, in November, 1988.

The information gathered during the project up to this point was general in nature, a macro-view of the forces and issues that would be important to IRS training in the near- and far-term. The two-day workshop was intended to look at specifics — the issues, possibilities, and problems as they appeared to seasoned IRS managers involved with training, from different locations and professional categories.

The workshop participants generally agreed with the factors and issues that had been identified during the project as the challenges facing IRS training. Difficulty in hiring and retaining qualified employees was seen as a major issue now, and one that would worsen in the next decade. The increasing importance of training would come from two sources: the need to build basic skills and technical proficiency in new employees, and frequent retraining for current employees as automation continued.

The workshop participants saw one of the trends in training to be a significant increase in individual training at workstations. As the work in the functional areas moves toward full automation, the computers that will be used for day-to-day work will be an employee's access to the majority of the training programs he or she will receive. This means that training files will be accessed over the same data lines.

One of the issues will be how to store and manage this type of training. For instance, should the training courses of the future be stored in the mainframes of the operational systems, or stored in a centralized database of training courses and transmitted electronically? Some of the answers to these questions were seen to depend on how well the agency could establish electronic connections between all of its computer systems, including the individual terminals or PCs that IRS employees will be using in offices and at field sites.

While participants saw a future of increasing amounts of training at workstations, they also felt that classrooms should not disappear altogether as a delivery system. Training in the organizational

culture of the IRS and in interpersonal skills were seen as courses that should continue to be taught in classroom situations.

Workshop attendees suggested field-based training/information centers, with both local classroom instruction and centrally-broadcast videoconferences. These centers were also seen as possible distribution "hubs" for centrally-developed courses in other electronic media.

Participants also discussed how changes could be brought about, and the organizational units that should be responsible. Many of the changes were seen to require central policy and coordination for successful implementation. An example was the need for agency-wide interoperability and interface of automated systems, data lines, and individual communication nodes.

Other issues involved the location of resources. The participants agreed that the IRS needed a level of in-house expertise in all the new technologies to at least design and monitor, if not develop, the sophisticated programs that would be required. With the limited resources available, the most effective approach would likely be through centralized expertise and course development. Some participants could see a future of isolated nodes of innovation, rather than Service-wide excellence, if resources were not centrally managed.

Each of the workshop discussion groups produced its own set of recommendations for the IRS Training System for the year 2000. The highlights of these recommendations included the following:

- workstation training as the primary delivery system, augmented by classroom and videoconferenced training at regional, district, and service center learning centers;
- learning centers with classrooms, computer labs, and videoconferencing capability in all districts, regions, and service centers;
- electronic connections between the learning centers and the field offices served by the centers;
- a centralized course development center, equipped with an online workstation from each operational system, and prototypes of systems under development;
- in-house design and programming expertise in each new technology application; and
- performance-based course design, based on critical job elements.

TRAINING 2000 — THE SYSTEM

Achieving the capabilities recommended by the IRS managers at the Leesburg workshop, and meeting projected needs of the workforce for technical and basic skills training, increased automation, and job redesign requirements, constitute the challenge for the IRS training system in the next decade. The optimum system must have:

1. *flexibility* — to deliver training on demand, at great distances, for multiple audiences and needs, in a continuous manner;

2. *efficiency* — in standardization among systems and technology, cost-controlling capabilities such as generic tax law lessons that can be adapted for different functional audiences, and training modules that can be grouped and regrouped as a course or used singly as refresher training, as needed;

3. *quality* — in terms of the access and use of all the technological tools available in the most powerfully designed formats that can be created, and in improvements to training programs based on evaluation of the impact on job performance.

An IRS training system with three major delivery modes can fulfill those capabilities and characteristics deemed necessary for the year 2000 and beyond. The three modes are the classroom, field learning centers, and the worksite (workstation and/or OJT).

The most important and consistent finding in the study is that IRS must use the systems that employees work with for delivering a major portion of training. Training must be available at the worksite, embedded in online applications as expert systems, through CBT courses, by means of desk guides, and with OJT coaches. However, it must also be recognized that there will be times when employees will need to be immersed in a total training environment. Thus, classroom and field learning centers will continue to play a key role in the career-long development of IRS employees.

Classroom delivery will consist of formal courses taught by experts in the content areas covered. Classroom instruction has been the backbone of training for many years and will continue as an important training delivery mode. Classroom instruction will be used for initial training to introduce new employees to IRS, and may be used in part throughout the technical or management training curricula when it is important to convey IRS culture, to add emphasis, to increase motivation, or in general to bring large groups together.

Learning centers equipped with conference space, CBT terminals, and video facilities will be the instructional situation of choice in several circumstances. Training in learning centers will be used to teach topics that require frequent interaction in small groups. Topics that require an instructor to model certain behaviors or advanced topics

that require discussion will be taught in learning centers. Training that combines CBT with practical problems, particularly those problems that are worked on by groups, will also be conducted in learning centers. Learning centers will have videoconferencing capability to allow many people at remote sites to engage in a dialogue, with experts and with each other, on important topics and current issues. Finally, learning centers will include self-instructional materials for independent study when this is combined with conferences, seminars, group activities, or coaching sessions.

Training delivered at the worksite will integrate a person's training with his/her work so that he/she can move freely between the two as needed. The workstations will be equipped with sufficient memory and storage to support embedded training that runs alongside applications programs. This type of delivery will make the training available on demand in the most cost-effective manner. Training at the workstation will be used for most automation training, as well as for other courses that do not require person-to-person interaction. OJT will be used for formal coaching programs when oversight, demonstrations, and frequent interactions are needed at the worksite.

The central idea behind the three types of training situations is that of comparative advantage when weighing costs and effectiveness. The delivery of cost-effective training throughout the IRS will require a mix of the training situations to optimize training effectiveness while containing training costs.

Classroom instruction has been the dominant, and often the only, form of instruction used for training in most circumstances within IRS. Of the 667 courses counted in the October, 1988 Training Program Index (Document 6172), 557 (83%) are designed for classroom delivery. The other courses are delivered through self-instruction and/or computer-based training, or the delivery mode has yet to be determined.

Classroom instruction will continue as one of the training delivery methods, but will be reduced to those situations in which it has an advantage when compared with other forms of instruction. Those times for assembled training will be chosen with care. As a rule, it will be more efficient to bring the training to the student, by means of distance learning capabilities, either at the workstations or at field learning centers.

In light of available technology and educational methodology, classroom training should be reduced considerably, learning center training increased somewhat, and workstation training increased significantly. The resulting mix will consist of workstation training at about 50% of all training, learning center training at about 30%, and classroom training at about 20%. These figures are estimates and will change somewhat as decisions about specific courses are made. This restructuring can be compared to a similar initiative at IBM, in

which classroom-based training is being shifted to about 25% of total training by the end of the decade. Currently, IBM has 50-50 mix of classroom and self-paced (computer and self-instruction) training.

A variety of media and technologies will be used to deliver training in classrooms, learning centers, and at the worksite. Of course, instructors will deliver some of the training, particularly the classroom instruction and on-the-job training. This instruction may be enhanced by print and still images from overhead projectors. Video will be used in the learning centers to show pre-recorded training tapes, generic cable network broadcasts, and live teleconferences. With the expected improvement and cost reduction in technology, videoconferencing may someday be available at the individual workstation.

Computer-based training will be a dominant training delivery medium, both in learning centers and at the workstation. Some CBT programs will be tutorials, delivered through networked minicomputers to terminals at the learning centers. Other CBT programs will be stand-alone, and delivered at the workstation. When stand-alone training is delivered in learning centers, learners can still sign on to a centralized computer system for test taking and record-keeping. This kind of computer-managed instruction takes advantage of a wide variety of individual and group delivery methods. Test security, scheduling and central recordkeeping are facilitated through computer managment of the training data.

These computer systems will be interconnected to allow for easy transmission of course material and data. Courses can be downloaded from a central courseware development facility, and evaluation data uploaded from the individual user. These same systems will also support computer conferencing software to permit user participation in asynchronous computer conferences. Individuals will communicate with one another via electronic mail (E-mail) systems. Thus, a learner at one location could get an expert's opinion on a matter even though the expert may be at a location remote to the learner. Likewise, a learner could interact with a coach via E-mail even though they may be remotely located from one another.

Much of the training material will be stored in digital form on optical media. Individuals can access information by means of CD-ROM drives attached to their computers, or through a central network via modems. The delivery can either be centralized at a learning center, or decentralized at the workstation.

A SCENARIO OF THE YEAR 2000

Imagine a revenue agent in a midwestern state who has been through his basic training and is working at his job. He receives word that he has been selected for additional training on Leveraged Buy Outs (LBOs). This is an advanced topic not included in his basic training, but essential to a part of his job. His "class" for this course is composed of 47 revenue agents scattered around the country, with the majority located in three large eastern cities.

After being notified of his selection, he receives some printed self-instructional materials on LBOs. After completing this, he reports to a nearby learning center, along with three other agents, and signs on to a CBT tutorial to examine the key elements of LBOs. His knowledge of the tax implications of LBOs is tested via CBT. Any gaps in his knowledge are detected and remediated through careful explanation and examples.

He then works through a series of computer-based simulations with the three other agents at the learning center. When the simulations are completed, an instructor assembles the agents for a debriefing on their work. Due to the limited availability of experts on LBOs, the instructor conducting the debriefing communicates with the students from a different location via two-way video facilities. Prior to the videoconference, the instructor accessed the learners' files to examine the responses they made during the simulations and diagnosed their weaknesses.

Once back on the job, the revenue agent calls up the simulated cases on his workstation to use as examples. After a few months have passed, he signs on to request the CBT course on LBOs to go through as refresher training. When working on a case, he can query an expert system to receive guidance on certain aspects of LBOs that he encounters infrequently. Finally, when he hits a problem he can't handle, he sends an E-mail note to his instructor.

SYSTEM REQUIREMENTS

Much is already in place to build the system, in terms of training technology initiatives and experience; nationwide plans for hardware, software, and telecommunications support; and system integration standards.

ATS Learning Centers. The existing ATS learning centers are located at 169 sites, including all regions, districts, service centers and large posts-of-duty. These centers will provide an automated training environment with full capability to deliver CBT courses and

automation support for administration, testing and evaluation. Video-teleconferencing downlinks can be installed at each ATS learning center through the current FTS 2000 government-wide procurement initiative. This will add the capability for receiving live broadcasts and generic cable networks to these field learning centers. As it becomes feasible, plans should be made to expand the facilities and administrative support at ATS learning centers to accommodate more students, more classes, larger groups for videoteleconferences, and to create more flexibility for this major delivery mode.

ISD Management Plan. The groundwork, laid by the Information System Development (ISD) organization for the redesigned integrated tax administration system, will provide the crucial environmental features, enabling the creation and support of the proposed training system. Of paramount importance is the national communications backbone that will allow any IRS user to receive data through telecommunications gateways from any database. When fully automated, the tax administration system planned by ISD will have three tiers of computing capability:

- Corporate systems to serve multiple user populations, e.g., Tax Information Database, Reference Database.

- Departmental systems to serve single function populations, e.g., Automated Examination System (AES), Automated Criminal Investigation (ACI), Integrated Collection System (ICS), Automated Taxpayer Service System (ATSS).

- End user applications to serve front-line employees.

Building on the concepts and categories of ISD, a corporate database of computer-based training (CBT) courses and modules could be created that would serve multiple user populations. The database could be accessed by any departmental system or end user, as well as by the CPU supporting the ATS learning center. Thus, one could access either a series of modules for delivery of a formal training program in the ATS learning centers, or individual modules for use as refreshers or informal tutoring sessions at employee workstations.

The connectivity capabilities of the current Consolidated Data Network (CDN) and the larger backbone connectivity capabilities planned for the integrated telecommunications network provide the linkage for the CBT corporate database to all department systems, other end users, and ATS learning centers. The system would allow functions the flexibility to decide how best to use training. Options would range from offering full courses at ATS learning centers to interspersing single sessions at workstations on the job.

The strategy of a CBT corporate database would also allow for generic authoring, i.e., development of generic modules on tax law that could be used by many different functions. Specialized modules

or wrap-around lessons that depict procedures and applications of the tax law specific to each function could also be developed.

There would be one common authoring system for all courses in the CBT database. The advantage would be that course designers and CBT authors would have to learn only one language in order to create and update these programs. Standards for integrating all systems in terms of training capabilities would have to be created and enforced through ISD standardization and integration requirements. For example, hardware for all systems would need to have minimum configurations for display screens; and response times for student interactions would need to be within certain parameters per number of users on the system.

The database would contain all CBT courseware, as well as testing, scheduling, and evaluation data, and employee development records. Thus, it would serve multiple functions related to training: delivery, administration, recordkeeping, and evaluation.

Departmental systems such as AES, ICS, AUR, ATSS, ACI, and IMS would also have to provide training that is application-specific. For example, such training might teach employees how to use the particular automated system to fulfill functional requirements. Much of this training might be embedded in the software itself, and may or may not resemble training courses that include job aids, expert systems, helps, and/or mini-tutorials. Each system could have a CBT authoring language to handle these training needs. It would not necessarily have to be the same one used to create the CBT corporate database, but could be selected according to suitability for meeting functional needs.

Course developers and instructional designers will need to build and maintain a database containing design tools and CBT routines, libraries of graphics and forms, expert systems to aid in design decisions, and task analysis data upon which to develop training course objectives. This will be compatible with the series of Human Resources databases already being planned by the Office of Technology and Worksystems Design for all support services provided by the Assistant Commissioner (HRMS).

Computer Hardware. Because of the nature of its work, the IRS is one of the most highly automated agencies in the Federal government. Mainframe computers store IRS records and administrative data in central locations. Other mainframes are installed or planned to automate and support functional processes. Thousands of laptops are already in the field, with more to follow. Each of these computers is a potential part of the training distribution system.

These computer resources, alone, give the IRS an enormous head start on the future. They are the basis for implementing all of the "powerful tools" of instructional design and enhanced productivity.

Video capability. The IRS already has an equipped video production studio. This expense alone is often the barrier that prevents an organization from installing videoconferencing as a distribution system for training and information.

This studio provides in-house capability to produce video-based teaching products. Today, these videotape products are integrated into both classroom and individual instruction. The studio could also provide the visual images for the "hypermedia" instruction of tomorrow. The IRS should consider upgrading its currently existing studio to one with broadcast capability.

Artificial intelligence capability. The programming expertise available in the AI Lab is a scarce and valuable resource. In addition, as discussed in the technology section on artificial intelligence, the expert systems being developed can be used in a training mode today, even though the learner models required for actual Intelligent Computer Assisted Instruction are still in the development stage.

Courses. Another resource is the hundreds of courses the IRS already has for technical, management, and executive training. Some organizations are still at the beginning stage of identifying what their employees do and what they need to know.

"Front-end analysis" to determine what needs to be taught is the most time-consuming and expensive part of course development. Even though the majority of IRS courses today are designed for classroom instruction or self-instruction, the knowledge and procedures seen as necessary for good performance have already been identified for many employee categories. Instructional design for new media will often be able to start with a knowledge base of what needs to be included as content.

In addition to classroom and self-instruction, computer-based courses also already exist, and more are being developed. Computer Services has developed programs for operators of UNIX-based systems. Service Centers have developed effective technical training programs. IVD programs are being offered in a few offices. CBT programs for functional training are being developed for distribution through ATS. Functional areas are designing embedded training on operational systems.

In-house course development expertise. The IRS has a cadre of training analysts and course designers, many of them well-experienced in systematic course design and development. Equally important, the IRS has at least a moderate level of experience in developing and distributing computer-based training. While the IRS will need to expand its course development expertise to fully utilize the power of the new technologies, this core of experience with machine instruction is an agency resource.

Standard procedures. The IRS has already developed agency standards for instructional development and information systems. The TDQAS approach provides the procedures for performance-based course design and evaluation that should underlie an agency-wide Training System. The media-selection models in TDQAS can be expanded to include technology-based media, and can provide the framework for decisions regarding which courses should be converted to other media, and what those media should be. Setting standards for each technology will be essential to contain costs and to ensure quality training programs.

The decision to establish an Assistant Commissioner for ISD to develop and maintain IRS standards for information systems was also a critically important move for the agency and for a future Training System. The problem of interface between computers, and interface between computers and employees, will be a major concern as technology continues to expand. IRS standards can establish the guidelines for overcoming interface problems with current hardware, and can help to alleviate these problems with future hardware for operations and training.

A DATABASE FOR TRAINING RESOURCE MANAGEMENT

A key to turning the extremely valuable resources listed above into a cost-effective, efficient IRS Training System is identifying the connections, duplications, gaps, and potential for future enhancement. This is a large task. It would have been an impossible task even a few years ago. The difference lies in technology and relational databases. Again, the IRS has an advantage in having the computer power to build and manage such a database.

In addition, software is currently available and being used for this type of resource management. As an example, the Army has a "living" Table of Organization and Equipment that is capable of tracking changes in regulations, training doctrine, or equipment throughout Army units down to the platoon level.

Another advantage in organizations like the IRS with widespread automation is that much of the data collection process itself can be automated. Data from organizational units, including field sites, can be transferred into the data base electronically, saving the expense and time of collection by other methods. The Consolidated Data Network could replace many paper based questionnaires or telephone calls.

The concept behind an integrated IRS Training System is that resources can be matched with training needs. The first set of data categories are the resources.

Resource Categories

The database would be built simultaneously in each of the following resource areas.

Computer Hardware. A key step to building an IRS Training System is a complete and detailed inventory of all IRS computer hardware currently in place or about to be issued or installed. One intent is to discover which of these computers are now or can be connected, to provide the beginnings of a system of workstation-based training. The second goal is to assess where computing power exists in the agency for course design and development and how it can be accessed.

Such a database may already exist for operational equipment. If so, training hardware can be added.

Items of interest from the standpoint of an integrated training system include:

- Type and description (e.g., mainframe computer with number of workstations, personal computer, laptop computer);
- Make and age;
- Location;
- Primary current use (e.g., data entry/retrieval, telecommunicating, training development, training delivery, etc.);
- Amount of current memory and potential for upgrade;
- Storage media capability (e.g., floppy disc including size, Winchester or Bernouli drive, full size laser disc, CD-ROM);
- Type of operating system(s) used;
- Current software;
- Telecommunications capability including transfer speed; and
- Current electronic interfaces with other equipment.

This information would be stored and updated centrally, but available to all locations to support training decisions. For example, a function planning a new training hardware procurement could assess whether hardware already exists that could be shared electronically, or determine characteristics the equipment must have in order to link with other units for shared course development or distribution activities.

This type of "living" inventory enables the monitoring of hardware changes throughout the agency for trends that can be the basis for other resource decisions. For instance, as CD-ROM drives that can support hypermedia become available at workstations, the need for hardware for IVD-based training will start to diminish. These resources can then be redirected.

Videoconferencing equipment. The equipment involved in transmitting and receiving videoconferences is another resource item.

Leased or owned equipment would be included by location and capability. Types and numbers of audio links, and supplementary equipment such as telefax machines that are committed to teleconferencing, would also be included.

Emerging and changing technology. The data showing trends in technology gathered through environmental scanning would be entered as a resource comparison category. The trends predicted for 2000 are rapidly changing as new breakthroughs occur almost weekly. The value of this data category would be in advance planning and awareness of potential impacts on in-place equipment.

Training facilities. Another resource category is the facilities currently committed to training activities. The computer hardware and videoconferencing equipment entered into the database would be subcategories, pulled by location. Other data items include number and size of rooms available for training activities, data lines available, audiovisual equipment, numbers and expertise of on-site training professionals, and estimated numbers of employees within a 30-mile radius.

Courses available. Another resource data category would be courses already available throughout the Service. The database would be started with the data listed in current catalogs, including subject area, length, location, current delivery (e.g., classroom, self-instruction plus video or CBT), and augmented with the same data about all of the specialized courses that have been developed in service centers, the functional areas, and administrative units. Type(s) of skill taught (e.g., following procedures to evaluate/analyze data) would be an additional data item.

Ultimately, this category would include detailed data on learning objectives and course content. These data could be entered in a number of formats (e.g., key word, abstract, course content) so that they could be accessed in varying levels of detail for different purposes.

One of the purposes of this database would be to identify common skills areas that could be combined into core courses across functions. A second would be to identify redundancies or gaps in current course offerings. A third would be to provide a systematic process for selecting courses to be adapted or revised for delivery through other media.

The process of establishing this database will also be an opportunity for a quality review of current courses against the standards of TDQAS, and for identifying courses that need to be improved or redesigned.

This type of course inventory and quality review was a keystone of IBM's successful reorganization of its entire training function. More

than 1,200 separate courses were reviewed to identify redundant and poor quality courses, as well as gaps in course offerings. The process took more than two years, and required the efforts of hundreds of instructional designers. However, this review and redesign, combined with electronic distribution methods for a number of courses, was shown in case studies using accounting techniques to cut training costs by 65% (Galagan, 1989). The IBM training vice president who directed this effort also noted that the key to success was to reinvest some of the savings to build new courses for the technology-based delivery systems.

Instructional development and training expertise. Another data category is the type and level of expertise and experience available throughout the Service to create the performance-based, innovative courses that will be required for future IRS training. All of the computer program designers and programmers throughout the agency, in addition to the kinds of expertise in the AI Lab, would be identified as potential resources for the move to workstation-based training.

Training professionals throughout the agency with experience in machine instruction design or development would be listed, in addition to designers experienced in developing performance-based instruction. This skills inventory will identify gaps that will need to be filled through either staff development or hiring.

An additional category would be the production specialists and their expertise in the Product Development Support Section, including the video production studio.

Needs Categories

The resource categories would be matched against training needs to find the most efficient, effective, and instructionally sound solution to meeting the need. Training needs come from both position requirements and individual development needs.

Position skill requirements. A major needs category of an IRS Training System is an index of the knowledges and skills required for successful performance in each IRS labor category or position description. Some of the data for this category could probably be transferred electronically from OPM data bases for civil service classifications. Critical performance items that have been identified in particular positions would be added, and those same types of performance requirements determined for any positions that have not been analyzed.

Like all of the data components, this category would need constant updating. Changes in equipment-based requirements such as telecommunicating or accessing CD-ROM storage could be a signal of a

needed training update for current employees and new initial training for recruits. Other changes such as those from new regulations might also be reflected in skill requirements. For example, expanded electronic filing to new categories of filers might include a requirement that additional categories of IRS field agents become knowledgeable about computerized records and tax filing software.

Employee development records. The intent of this data category would be to establish individual professional development records for each employee as the basis for career-long training and educational opportunities. The content of this record would depend on the type of training management system put in place. At a minimum, each record would probably include employment history in the agency and previously, education and training, including level of formal education completed, training courses completed, performance-level attained, and other development items such as special licenses or certificates, foreign language proficiency, or other special aptitudes.

A new employees entry record could also include identified training needs, updated as each training course is completed. Part of the power of a relational database is that the computer will update individual records automatically as changes in performance requirements for a particular assignment are added, or as computer capabilities change at a particular location.

If desired, performance on all computer-based courses could be programmed to feed into individual files at the same time they are routed to the course evaluation file maintained in a training management office. As computer-based adaptive testing becomes available, skill levels in key performance categories could be evaluated online, and used to select the levels of training packages to be presented.

These records could be used in two equally valuable ways for employee assignments. As employees need to be shifted laterally with changing work requirements, individual skills can be compared to the requirements of the new positions, and both individual and unit-wide training needs identified. Secondly, as impending changes are noted, individual records can be searched for employees who have the closest skills and preparation for the new requirements.

This type of automated identification and tracking is already in use in the military, in other agencies such as the FAA, and in a growing number of companies like IBM. In addition, other public agencies are implementing these types of systems. The State of Michigan recently issued "smart cards" to the thousands of citizens involved in state-sponsored employment and training programs. These cards, the size of a regular credit card, hold in digital form, all of the information regarding the participants' background, employment history, education, training, and track through the state system. The cards are "read" by lasers attached to computers at each state location involved in employment and training (*Labor Notes*, April, 1989).

Individual professional development records are the basis for the professional development sequences called for in the Volker Report (1989) to provide the type of opportunity that will be critical to recruiting and retaining scarce highly-qualified employees. They can also be the basis for planning and implementing the types of basic skills interventions that will become more critical in some IRS regions as labor markets tighten and employees skills must be enhanced in-house to produce a skilled and productive workforce.

Managing the Resources to Meet the Needs

The data categories described above can be compared in many ways to provide the information necessary for an effective and efficient IRS training system. Training evaluations conducted online at the end of courses and training sequences could be used to evaluate the strengths and weaknesses of the new technologies and different course designs. New or changing training needs could be identified for functional area or locality. Training management of course scheduling and distribution would be aided by comparing hardware availability with need.

The impact of each piece of new equipment on training and connectivity could be analyzed ahead of time, and resources committed to integrating the equipment into the training system.

The current tasks involved in an operation could be compared against the proposed characteristics of new equipment to identify gaps. These gaps could then be analyzed to determine if they could be met with training. If not, the equipment could be returned for redesign at the concept or requirements stage, before resources were committed to equipment that could not be used efficiently. This type of analysis is already conducted in the military services under various names like MANPRINT (Manpower, Personnel and Integrated Training).

Similarly, at the beginning of the move toward training offered at the workstation, selections for first course development could be made on greatest need determined by numbers of people who will use the equipment and their skill levels. The examples of this type of evaluation and management are endless.

One of the primary benefits of establishing this type of database is that operations and training are integrated into a single system for resource management and planning. This type of integration is going to be increasingly important to utilizing the powerful tools that are at the heart of IRS work, and hold the most promise for increasing productivity and performance by tapping the full limits of human capacity (Ofiesh, 1989).

PUTTING THE PIECES TOGETHER

Building the IRS Training System of 2000 and beyond is a process of identifying, connecting, enhancing, and filling the gaps toward a comprehensive, flexible training and professional development program for all IRS employees. A relational database to manage these resources will be a primary factor in decisions about long-term resourcing.

In addition, automated decision support systems are becoming available that can guide planners and decision-makers through an analysis of all the factors involved in decision situations, and allow "what-if" exercises to be run to evaluate options. Given the complexity of the IRS mission, employee needs, and critical resource requirements, this type of analysis would be extremely valuable. Again, the IRS has the computer capability inhouse to support this kind of analysis. The software would be a minor investment compared to the potential saving.

IMPLICATIONS FOR IRS

The proposed goal is to build an integrated training system with three primary components:

- Centralized course development, distribution, evaluation, and management — linked to —
- Field-based ATS Learning Centers with classrooms, videoconferencing facilities, and computer labs for individual testing and training — linked to —
- Individualized workstation-based training for all employees

Part of the long-term strategy is to 1) use connectivity and physical location to "leverage" resources into components that are more effective together than by themselves; 2) maintain as much flexibility as possible in hardware and software decisions, and 3) to conduct rigorous prototype testing of all new design and delivery methods before committing full-scale resources to change.

To achieve the ideal training system, the IRS must build on initiatives it has already taken, as well as plan activities on a number of other fronts. There are two areas of implications for IRS: the development and enhancement of specific training system capabilities, and the creation or expansion of organization-wide, cross-functional support programs. Implications are described in each area.

TRAINING SYSTEM CAPABILITIES

In the area of training system capabilities, IRS should consider moving ahead to develop embedded training in the software applications of major information systems projects as an important step toward the goal of increasing training at workstations. Maintaining the ATS Learning Centers, placing videoteleconferencing downlinks at each of these local field training sites, and pursuing plans to create a centralized, technology-based course development center are also important directions for this area. Finally, IRS must place a high priority on establishing quality guidelines for the use of new technologies and methodologies in employee training, and expand the skillbase of the training staff to exploit the power of individualized, interactive media.

Embedded Training

This study found a clear trend towards merging training with work using the workstation as a training resource. This requires that training material be embedded in, or run concurrently with, the applications software that employees use. In this manner an employee may move freely back and forth between using the application to complete a work task and using embedded training to learn more about the application when necessary.

Embedded training reduces the need for costly classroom training and provides training to employees at the point in time and the location where they need it. This results in a "graying" of work and training, a saving of training time and costs, and an increase in employee productivity.

Embedded training includes any form of instruction delivered on an operational system itself, such as helps, tutorials on the system, tutorials on applications, or simulations to teach advanced problem-solving skills. The definition also includes both programmed and expert system instruction in the above categories.

The process of embedding training into new operational equipment will require early involvement in the acquisition process, at the time that requirements are being written for the inhouse engineering process. Memory needs and special configurations required for embedding should be included in requirements definitions from the beginning.

Distributing and managing a workstation-based embedded training system will ultimately depend on links between operational equipment and the Learning Centers. The database of hardware characteristics will be a primary source of information in establishing these links.

Training System Capabilities

The retrofitting of training into existing operating systems will be a long-term process. Some of the current automation efforts in the functional areas have planned for memory and configurations for training within the hardware system itself. Some of this need may be alleviated as courses from the CBT database accessed through the Consolidated Data Network (CDN) are moved in and out of the workstation as employees finish stages of training.

Embedding training is going to require a large number of skilled and experienced course designers familiar with this type of delivery. The IRS will need to develop that skill inhouse and/or hire new levels of expertise. The IRS should consider establishing a close connection between the work going on in the AI Lab and the thrust toward embedded training. In addition to developing course materials, the inhouse staff must have the capability to ensure that contractor-provided products meet IRS needs and standards.

Rationale: The number and variety of automated systems already in place present an instant delivery system that is available to the majority of IRS employees for individualized instruction. Self-instruction has been shown to be as effective, or more so, than traditional, classroom instruction (Budd, 1987). Instruction at individual workstations is one of the most effective ways to leverage scarce resources for training, employee development, and organizational communication and coordination.

Other organizations are moving steadily in the direction of training delivered at the workstation (Horine and Erickson, 1986). National television ads are reinforcing the idea of embedded training by showing apprehensive employees finding a new workstation on their desks, only to be greeted by a "user friendly" embedded program, ready to walk the novice into yet another system to be mastered.

One of the thrusts of an integrated IRS Training System is to leverage resources and use current capabilities to their fullest extent. Training embedded in operational systems will undoubtedly be one of the most versatile and efficient means of meeting future instructional needs.

Distributed Learning Centers

An important conclusion drawn from this study is that scarce training resources should be leveraged through technology-based systems for distance learning. The key component in this process for IRS could be a series of learning centers with classrooms, videoconferencing facilities, and computer labs for individual testing and instruction. These learning centers could serve as the link between National Office training development and management and workstation-based training for individual employees. Individualized training could be

selected and delivered based on employee training needs and specific job requirements.

The IRS should consider using the current Zilog-based Automated Training System (ATS) as the base for the hardware, sites, and facilities of learning centers. If the ATS hardware can be enhanced, it could form the framework for the Centers, which could be constructed using a "building block" approach by adding videoconferencing and expanded classroom facilities.

Since the current ATS hardware is ultimately to be upgraded, the IRS should consider using the hardware resource as fully as possible until completing transition to more powerful computers. One possibility would be to use the computers as hosts for computer conferencing software, as a test bed for correspondence courses augmented by an "electronic classroom." Learners who have access to a computer with a modem, either at work or at home, could access the computer over direct-dial telephone lines from any location.

Additionally, video training could be coordinated and followed up by means of online discussion on computer conferences. International Business Issues Network in San Diego is making wide use of this form of delivery. Videoconferences with international experts are beamed to central locations in major cities. Participants then use computer conferencing for follow-up discussions, with the expert presenters leading the discussion (T. Miner, pers. comm. 2/13/89).

Another consideration for the transition period is that current ATS hardware could provide practice stations for material presented by videoconference. Co-locating the videoconference downlinks at ATS sites would provide the test bed for this multi-media instruction.

Rationale: The proposed configuration for the IRS training system is workstation-based training, augmented by local learning centers with designated service areas and regional classrooms. This layered approach maintains a high degree of quality control and training management, while remaining responsive to individual training needs at the worksite.

IBM, Xerox, McDonnell Douglas, Boeing, Federal Express, and AT&T are only a few of the major corporations with field-based learning centers. The military services use their professional area schools in much the same way, as distribution centers for scarce training. The U.S. Army is proposing to deliver over one-half of its training through distance learning at distributed learning centers by the year 2000.

With declining resources and increasing workload, IRS training must make efficient and effective use of technology. Reduced travel funds and increasing workload within the Service itself will make it more and more difficult for employees to get to regional classrooms for

instruction. There are substantial cost differences with different training delivery modes. For example, IBM determined that it costs $350 per person per day for central classroom training, $150 for onsite learning center training, $125 for satellite delivery, and $74 for self-study such as CBT or print materials. While some courses will continue to be classroom taught, the need for group, in-person instruction should be determined by subject matter and purpose of training, rather than by default or the lack of other delivery systems.

Centralized Course Development Center

Because of the need to move toward efficient development of technology-based training and the need for training to contribute to the organization's overall effectiveness, IRS should continue to pursue its plans for a centralized course development center. This center should be a state-of-the-art training facility that would oversee professional development, training technology, and course design and evaluation.

The IRS should consider centralizing and coordinating all facets of IRS professional training. Integration of course development and field support will become increasingly important as the IRS moves toward designing and delivering workstation-based, individualized training. Instructional designers would play an integral part in synthesizing methodology, course design and content, and delivery systems.

A technology lab and a usability lab would be situated at this center. The technology lab would contain online units of all IRS operating equipment and prototypes of hardware being developed so that instructional designers can locate the areas that require embedded training and the applications that must be designed into training modules.

In the usability lab, all training modules would be evaluated for screen design, course design, and learner ease of access. This would also be the developmental lab for testing and developing interface standards for Human-Computer Interface (HCI).

Training courses would be designed in this Center for distribution to the learning centers, and managed and evaluated online from each distribution site. The Center would be electronically connected to sites of expertise throughout the Service, including the video production studio for electronic transfer of video images for hypermedia development.

In addition, the course designers and programmers would make frequent use of the videoconference capability to coordinate with functional areas and other course development specialists. This has been found to be an effective way for functional experts at remote

sites to review stages of development and coordinate comments and suggestions. The Boeing company uses this type of video coordination for design and development activities throughout the company.

Finally, in addition to uniting all components of the Office of Training Program Management, the Center would provide physical space in the form of meeting and classrooms for special task forces, pilot instruction, and training the trainers.

Rationale: The Service faces extremely difficult and complex course development and design challenges if a workstation-based training system is to be fully implemented. Locating some of the primary resources at a single site with online or prototype workstations to use for course design will greatly facilitate this process. In addition, having the technology in one place will enhance consistency and promote quality standards. It will also facilitate generic training and development of the core courses that will streamline the course offerings of the Service. In addition, tax law can be shared across functions.

To help alleviate burgeoning training requirements and to make training more efficient and cost effective, some Federal agencies and organizations already have, or are establishing, centralized training course development centers. For example, the Federal Aviation Administration has a training academy in Oklahoma City that is responsible for all elements of course design for its professional personnel. The Federal Deposit Insurance Corporation has recently proposed and received approval for a training center.

In addition to these Federal agencies, private industry has its own examples of centralized training development facilities. Xerox and IBM are two prominent corporations that have centralized locations. Of particular significance is IBM's return to centralized training development after more than 20 years of decentralized training development. During this time period, IBM discovered that courses were duplicated, non-essential courses were offered, training was incomplete, costs were skyrocketing, and quality was unmeasured. Additionally, delivery systems and measurement systems varied throughout the company (Galagan, 1989).

In light of these discoveries, IBM recognized the need to centralize its training efforts once again. Some results of the restructuring include ensuring that courses are linked to jobs or job categories, using instructional designers to develop courses, building quality measurements and student evaluations into training, and using advanced technology more frequently to train employees. All of these results were aimed at reducing training costs, providing necessary and relevant training, and promoting the transference of learned skills to the worksite.

By creating a centralized course development facility, the IRS could promote similar training opportunities and advantages. Since many jobs are already categorized by function, existing course offerings, as well as new courses, could be integrated across functions to eliminate duplications. The technology and usability labs in the facility would allow course production that could be tailored to individuals or groups of individuals and their training needs. Since technology is likely to become more involved in training over time, these labs would be useful in demonstrating which delivery systems would enhance learning in given situations.

Further, the resources at this facility would provide the appropriate setting for the creation of measurement, evaluation, and man/machine interface standards for training throughout the IRS.

Quality Review Guidelines for the Optimal Selection, Design, and Use of Each Specific New Technology

Another implication of this study is that quality guidelines for training programs should be followed. Only by following appropriate guidelines can training programs ensure their effectiveness and efficiency. Thus, all courses in the Internal Revenue Service should follow general quality guidelines set forth in the Training Development Quality Assurance System (TDQAS). The systems approach, upon which the TDQAS is based, has been cited as essential during times of economic stress and downsizing (Odiorne, 1989).

Standards for training development, such as TDQAS, are important in any training situation, but these standards are even more essential when the training is to be delivered via technology. Because of the complex nature of training development for technology driven delivery and the fact that many people are required for developing the training, quality standards are essential to effective training.

The inclusion of performance analysis as an early step in the quality guidelines, as recommended in TDQAS, will ensure that training resources are not wasted developing training programs that try to solve performance problems that are not due to employees' lack of knowledge or skill. Training will be selected as an option for solving performance problems only when it is appropriate (Jonassen, 1989).

One of the primary considerations of an integrated training system will be the identification of current courses to be redesigned for distribution through new distribution systems, and the selection of the appropriate distribution system for courses to be developed.

Standards for media selection and quality in the Training Development Quality Assurance System need to be expanded to all of the

new training technologies, and to the courses that will be distributed on these systems.

The newly automated Training Program Index provides the opportunity to review current courses. This evaluation would have three related purposes: (1) to seek the commonalities and duplications that could be combined into core courses or curricula for common instruction across functional areas, (2) to identify courses that are likely candidates for distributed or individual instruction, and (3) to do a quality review of current courses against TDQAS standards and the principles of effective adult learning.

One of the thrusts of the integrated training system is to reduce redundancy of course offerings, and to combine courses in common cores that can be distributed in the Learning Centers and at individual workstations. A second focus is to create career-long sequences of courses that are part of an employee development plan. The need for course development efforts during this restructuring will be enormous. The resources already available in current course offerings must be evaluated in terms of content and performance requirements, and then used as efficiently as possible.

Rationale: The course development that will be part of the implementation of the integrated training system is going to be an extremely challenging task. In addition, the redesign of current courses for other distribution systems and other media will also require an in-depth knowledge of course design and quality standards. The review and evaluation of current courses is an excellent opportunity for gaining that knowledge and making it available to course developers.

In addition, the development of quality review guidelines for the new media is going to be critical. Course designers will be faced with difficult and challenging media choices and decisions regarding what design guidelines to follow. One factor that will help them will be the knowledge of learning theories and strategies that can transform the new technology into powerful teaching tools for adult learners. Courses can be updated with the results of each prototype; this new data will be a source of valuable knowledge as the new technologies are implemented.

Development Program for IRS Training Professionals

Another implication of this study is the need for development programs for training professionals. New approaches to training which are vital for the future of training will require new knowledge and skills. IRS must consider expanding its present development program for training professionals in order to meet the challenge of providing effective and efficient training programs in the next decade.

There is a critical need for instructional designers who understand the new technologies and can use them to their fullest capacity to improve employee performance and productivity. The focus will be on individual instruction, and on designing around individual training needs and skill levels. With the new, sophisticated technology, the learning curve will be steep. Based on the results of the training expertise inventory for the database, the IRS should consider starting now to fill any gaps that are identified, and to increase the skill levels of current inhouse expertise.

Instructional designers will continue to have to know how to design performance-based courses that can be evaluated against student learning objectives and job tasks. The online testing and evaluation that will be part of a workstation-based training program will require this type of knowledge and precision in the design process.

Emerging tools like CD-ROM that will make hypertext-media design strategies possible are going to break the barriers between computer-based training and interactive videodisc. The IRS expertise in CBT will need to be upgraded to match that required for the design of interactive multimedia.

Another skill area will involve working with and managing the vendor and consultant efforts that will be required to mount a project of this scope. Even those training professionals who do not do sophisticated programming or design themselves will have to know how to recognize the quality of outside products.

Another area that will require high levels of experience and training is diagnostic and adaptive testing. This emerging tool will be at the heart of level-specific training design, and will need to be rigorously constructed.

The IRS should also consider developing a series of expert-system authoring packages to assist designers with complex design. The work going on at the Army Research Institute (ARI) in automated authoring is promising, and will be implemented in prototype later this year. The IRS AI Lab has just begun to be used as a resource for developing this skill in the Office of Training Program Management.

Other employees to be considered for development programs are the field trainers who implement and administer training. This will be particularly important for the personnel who will staff the learning centers. They will be the ones who will monitor individual training for the employees in their service area, and will coordinate the integration of new training programs into operational systems.

The videobroadcast capability should be considered a tool for distributing training programs to these field trainers. In addition, the classroom and on-the-job functional trainers should also have training

presented on how to integrate their presentations with the workstation-based training that will predominate.

Rationale: The instructional designers who will implement the IRS training system through new courses for workstation-based training and the other sophisticated technologies hold the key to IRS training success. As Oflesh (1989) notes, these tools can tap human capacity, but not unless they are understood and used to their fullest capability. Training and preparation for these specialists are an important IRS investment in the success of the implementation.

Changes in how training programs are delivered will lead to changes in the knowledge and skills required by persons designing the training programs. Just as different skills were called for when stand-up trainers began developing programmed instruction or when text developers began creating CBT, different skills will be needed for developing training that takes advantage of the technological advances cited in this study. An implication of this study is that IRS trainers will themselves require additional training. This professional development of the training staff can utilize the technology suggested in this report.

The field trainers in the learning centers are the second "tier" in the three-level IRS approach of centralized development, local learning center management and distribution, and workstation distribution. The expertise and knowledge of the learning center staff is critical to success. Development programs for field office training staff could be offered through the distributed training systems, including the ATS-based learning centers, video and computer conferencing, and/or videotaped presentations.

Providing automation support to course developers is an extremely efficient approach to the problem. This would include the use of Artificial Intelligence in automated authoring systems. These aids could be used to prompt developers in defining course content, in sequencing material, and in developing presentation displays, as well as other instructional strategies.

An additional consideration is the expansion and elevation of the professional career sequence currently available to IRS EDAs and EDSs. These career tracks will probably be necessary to attract and retain the high quality professionals required to develop and sustain an integrated training program for the next century.

ORGANIZATIONAL SUPPORT

In the area of implications that suggest the need for organization-wide, cross-functional support activities, IRS should consider the value of broadening its current standardization efforts so that automated training systems and work systems all share a common

interface. Using automation, IRS should look to a centrally-managed system of career-long tracking for employee development and a comprehensive evaluation monitoring system that will establish the links between training effectiveness and job performance. To fully implement an integrated training system such as the one proposed, IRS should consider a reassessment of training's role and level of advocacy within the organization, and most importantly, the creation of a multidisciplinary "change staff" to oversee the various initiatives that will required.

Standardized Training/Operational User Interfaces

The IRS should consider establishing its own set of Service-wide standards for hardware interfaces that are common to all operational and training systems. Since more work and more training will be done at workstations, the service should explore the creation of standards for screen design, menus, command language, and formats for all IRS operational and training systems.

The interface standards used in training should correspond to those that will be used at the worksite. Therefore, the standards would need to be tested on each course and operational application. Further, this means that specifications for interface standards would need to be included as a part of the procurement documentation for training and operational delivery systems.

Additionally, standards for hardware interfaces should be flexible enough to accommodate both the novice and experienced user.

Rationale: For many years, human factors psychologists and engineers have conducted research on man/machine interfaces. Today, the field known as Human-Computer Interface (HCI) is an extremely fast-growing professional area that is developing a body of knowledge about what characteristics of a computer screen and access tools are likely to improve performance.

Increased numbers of IRS employees are being required to use computers in their operational work. This trend will continue on into the 21st century. Many of the employees using computers may have limited experience. Also, some of these employees may be using computers for tasks different from the ones they perform now. Standardized user interfaces will accelerate training and improve transferability of training to the workplace. The standards that are developed should be obtainable across all IRS computers, including operational systems, information systems, PCs, and lap tops.

Ortega (1989) notes that computer screens today are designed by experts for experts. Research into novice/expert performance indicates that there are major differences between novice and expert computer users. Experts have developed mental models which are

able to predict what will happen next and which provide a broader understanding of the principles and logic involved. Novices, on the other hand, focus on the surface features they observe and lack the ability to predict.

Only experts can understand the underlying principles behind the prompts that appear or the error messages that demand a response. Standardized interfaces designed with novices in mind would promote productivity and more effective performance without penalizing expert users.

Employee Testing and Tracking for Career-long Development

With the power of automation, individual employees can be tracked in a career-long professional development system. Individual skill areas, training history, and potential career paths can be identified and managed. Employee development needs can be cross-matched with training opportunities and duties to ensure the acquisition of new skill levels.

The IRS should consider establishing this type of system for all professional development, from entry-level through management and executive ranks. Such information will be valuable in planning personnel moves in a time of changing workplace requirements. In addition, the Service will face the problem of a large number of middle-aged employees who have insufficient opportunity for advancement. Carefully planned lateral career moves to challenging positions will be an important way to retain these skilled workers.

The Human Resources Office of Research, Planning and Development in fact, has begun working on a Career Counseling Program. The primary focus of this effort is to assist and support managers in providing career advice for their employees. Using customized CareerPoint software, employees will be able to evaluate their interests, skills and preferences; review as many as 150 position descriptions; and identify as many as 50 resources to meet specific needs. This information could prove to be an inportant source of data for managers as they work with employees to develop Individual Development Plans (IDPs).

As noted in the earlier section on professional development records, agencies are using "smart cards" or online records to move quickly toward this type of tracking. This database category will be a tool for providing the professional development programs called for in the Volker Report (1989) as being key to recruiting and retaining scarce, highly skilled employees. It will also be a tool for managing and developing the careers of the future employees. Training and career management are going to be crucial in a workforce consisting of many labor categories, such as first-time women employees, who may have special training needs.

One tool that may help in establishing skill levels and in the planning of a development program is a system of adaptive testing, given online in the Learning Centers. A Tri-Service Adaptive Testing Initiative that has been ongoing in the Army Research Institute is in the proving stage, as field tests are conducted under the lead of the Navy Personnel Research and Development Center (E. Johnson, pers. comm., 4/24/89). This, and other computerized assessment tools, will become available over the next decade, and can be utilized to establish a data bank of employee skills and needs.

Rationale: A large number of private companies manage and track their employees through career-long development programs, and maintain planned succession paths for their key positions. This type of opportunity is what attracts talented workers.

Other Federal agencies, including the FAA and all branches of the military, manage the training opportunities and placement opportunities for their employees through computerized individual records.

This kind of employee development demonstrates an organization's commitment to its human resources and is a strong factor in retention and recruitment.

Comprehensive Evaluation Systems to Monitor Learning Effectiveness and Job Performance

The IRS should consider developing a comprehensive evaluation process for all training programs and individual courses. A clear implication from this study is the need to monitor learning effectiveness and subsequent job performance, and that these data should be examined routinely to improve the training system.

Procedures and standards should be developed to evaluate current and future courses in four steps (Kirkpatrick, 1967):

Reaction: How well did the learner like the course?

Learning: What principles, facts, and procedures were learned? What attitudes were changed?

Behavior: What changes in job behavior (performance) resulted from the course?

Results: What were the tangible results of the program in terms of reduced cost, improved quality, improved quantity, etc.?

Data on learner reaction is gathered by questionnaire or interview. Learning is measured by objective evaluations of student mastery of course performance objectives. Behavior is evaluated through

specific measures of improved job performance after the course. Kirkpatrick (1967) suggests that it is extremely difficult to evaluate some kinds of training results. He recommends that training managers evaluate the first three factors, and then consider results in conjunction with functional managers and executives in the organization.

In addition to single course evaluation, the IRS should consider establishing a database of evaluation data so that training effectiveness can be monitored over time and in specific areas of interest, e.g., a key professional function or a new technology.

Evaluation data should be used to identify both problem areas and examples of excellence, and discussed with everyone involved in the design, development, and delivery process. Evaluation data also become a key input to planning processes for resource allocation. Problem areas or special needs will necessitate reallocation or rescheduling of both short- and long-term resources.

Rationale: One of the major benefits of an integrated training system is that quality assurance can be built into the process at each step of design, development, and delivery. This will be an extremely important factor as IRS training expands to distance, embedded, and self-paced programs, using new technologies that are more demanding in terms of design strategies. A poor training module developed for classroom instruction can be modified "on the spot" with the aid of the live instructors. A poor embedded training system must stand alone and will result in great confusion and wasted resources before it can be revised.

All organizations faced with declining or stable training resources and increasing training demands will have to be far more quality conscious than before. IBM totally revised its courses based on performance objectives; this firm points to good instructional design as one of the key components of its training success. Many organizations, including the FAA, IBM, Raytheon, AT&T, Federal Express, and Xerox have rigorous prototype-based evaluations before new courses are released for distribution. They also have ongoing evaluation programs that measure training results against the objectives and job tasks that were the basis of the course design.

Evaluation based on the bottom-line results of job performance holds the greatest promise for cost savings within an organization. When reliable data are available to link training results to job performance, the true value (or nonvalue) of courses will become apparent, and training can be significantly fine-tuned to focus on areas of critical need and high impact.

A "usability lab" and classrooms for prototypes discussed earlier in this section, would be important additions to the implementation of a systematic evaluation program.

Information from the evaluation of courses and programs is one of the most useful database categories for the ongoing planning and implementation of IRS Training 2000. The effectiveness and usability of technologies will provide valuable guidance to the succeeding stages of implementation. Distribution systems that are not producing consistently high evaluation scores can be re-evaluated for improvements or possible elimination from further development.

Integrated Training Management at the Executive Level

Because of the increasing need for training to ensure that organizational objectives are met and the pivotal role it must play in the successful implementation of both worksystems and training systems, the training function will need advocacy at a high organizational level.

The trends in the workforce and the IRS workplace described in this report point to an increasingly important role for training. In addition, technology thrusts such as embedded training and a CBT database will require close coordination between training systems, information systems, and functional areas. These needs can best be met if professional training is integrated into a single organizational unit with advocacy at the executive level within the organization.

Newell (1988), writing about the growing role for training in all federal organizations, notes that this type of organizational structure is likely to become the norm in the next decade. He projects that federal training offices will be moved out of personnel departments and elevated within the organization as their significance becomes more widely accepted.

This trend will be consistent with the industrial restructuring that is moving training into new prominence. IBM's successful effort moved the head of training into a position parallel to the vice presidents for operations and marketing. The results have been dramatic from the standpoints of both operational efficiency and training cost-effectiveness. As Galagan (1989) notes, operations and training are now integrated functions. Making education the supporting base of the management system triangle means that it is part of every operating plan. As for cost-effectiveness, a vice president position for training was the necessary precursor to totally centralizing, integrating, and redesigning the training approach.

Today, education specialists at IBM maintain a total system of employee development that includes tracking 340,000 employees through 84 separate job categories, from entry level to upper management. The training itself is well-designed and cost-effective. After decentralizing in the 1960's and 70's, IBM was spending over $900 million a year on a "cafeteria" of thousands of courses. With recentralized training under a vice president, the courses were culled

for duplication, grouped into categories, and redesigned to focus on electronic delivery. Centralized management, instructional design techniques, and more technology for decentralized delivery was shown through actual case studies using accounting methods to reduce training costs by as much as 65% at IBM (Galagan, 1989).

While IBM returned to centralized management and executive-level training responsibility, other organizations have been long-term advocates of this approach. U.S. examples range from McDonald's famous "Hamburger U," to Weyerhaeuser, AT&T, and General Motors. The Japanese model of management, as practiced by such giants as Mitsubishi and Subaru, places training as a separate, executive-level function, distinct from other personnel matters. All major airlines, both foreign and domestic, have a corporate officer responsible for training, and an integrated, company-wide training and development program.

Perhaps the most prominent example of this type of organization is the U.S. military. While all services practice some form of centralized training and career management, the U.S. Army is the exemplar organization. By its size and its mission, the Army faces some of the most complex and fast-changing training needs of any organization in the world.

The Army's Training and Doctrine Command (TRADOC) is responsible for the entire training mission for all 720,000 Army members. The four-star general who heads TRADOC is equal in rank to the Deputy Chief of Staff in charge of operations and the Chief of Staff of the Army. The coordination and integration between training and operations is complete, from the Pentagon to the smallest field unit.

Rationale: The basis for this line of thinking comes from organizational theory. In the IRS, as in the Army, training is the "new product development" function, and as such, is part of the "operational spine" of the organization (Harris, Rigby, and Jacobs, 1988). The functions of the operational spine should be located at the executive decision level in an organization so that the critical work of the organization can get done.

Further, instructional designers can make the greatest impact on productivity through embedded training, expert systems, and improved human-computer interfaces. For this to happen, training must be an integral part of all operational planning, not brought in to solve problems later with a training "band-aid" for operational problems.

The connections between operational work, information flow, and training are especially critical in an information-based organization like the IRS where information is the primary end-product of the organization. All three functions need equal consideration for increased efficiency and productivity. If the organization is not

structured to facilitate the flow of information, training, in and of itself, can do little to affect productivity or skill levels. With the training function positioned on an equal basis with operational and information management, coordination and integration from the top could be a primary tool for identifying and finding solutions to disconnects between functions.

Integrated training with executive-level advocacy is going to become more and more prevalent as organizations face the accelerating training needs brought on by technology and demographics. These needs are already great in the IRS, and will be increasing. This type of organizational structure would provide the emphasis and the coordination that will be important in the positioning of the IRS for the future.

"Change Staff"

The final implication of this study is the need to establish a group with responsibility for implementing changes in the ways training is developed and delivered. It is clear from this study that carrying on business as usual in the training organization will not be acceptable in the near future. Traditional approaches to training are too expensive and alone will not be effective enough to carry the Service into the twenty-first century. This study documented the increased pressures that will be placed on training by changes in the workforce and the workplace. In order to respond to these changes, the Internal Revenue Service should consider establishing a "change staff" with responsibility for planning and implementing the new training system that will be required.

The purpose of a "change staff" could be threefold: 1) to plan for and implement the various initiatives called for in establishing the integrated Training System for IRS 2000, 2) to focus attention on the thrust toward an integrated IRS Training System, and 3) to build a sense of involvement and commitment throughout the organization. Some work has already begun. Prototypes for comprehensive evaluation systems, instructional videoteleconferences, and expert systems have been initiated by training staff and their functional clients. In addition, these groups are increasing the number of CBT courses and are exploring ways to develop embedded training in automated systems.

The core of the "change staff" could be those in the IRS training function who will oversee the long-term implementation. This core group would be augmented by identified representation from across the Service, including functional areas, Information Systems, the Artificial Intelligence Lab, Computer Services, Human Resources' Technology and Work Systems Design, and the other organizational units with training responsibility.

The group could function much like a project management office, planning and coordinating the various initiatives that will be required for implementation. An added function would be promoting the effort throughout the organization through employee information efforts and visible public relations programs to build acceptance and enthusiasm.

Utilizing a "building block" approach to develop an integrated Training System will require careful planning. Procurement cycles will be a critical issue, together with budgeting and securing the resources needed at each step of the implementation. The first task of the "change staff" will be to establish the database to help with these decisions.

Rationale: An IRS Training System will require a long-term planning and resourcing effort, as well as the commitment of all of the training professionals in the agency.

A second point is that implementation is going to require significant changes throughout the organization. The chances for success will be greatly increased if some of the impetus for this change comes from within the organization itself. This type of commitment can be built by having representatives of all of the affected groups serve as "change agents," working within their own organizational units to increase understanding of the change and its impacts.

Organizational theorists stress the importance of involving all affected groups in a broad-based "change staff" (Mayon-White, 1986). Involving the key people who can affect the ultimate outcome from the start can create a sense of commitment and "ownership" that is critical to later success.

SUMMARY

The intent of this study was to examine forces at play in society and in IRS that will likely impact how IRS should position itself to deliver training support for the future. Analysis of the findings of this study have yielded several important implications for how the Service might shape its training efforts to meet the challenge of the coming years. Business as usual with its heavy emphasis on lecture-based classroom training is not going to be adequate. Changes in the workforce and the workplace, coupled with developments in technology and new educational approaches, require an evolution in IRS's approach to training.

The implications described in this chapter could be the basis for shifting and defining the focus of IRS's training in ways that enable the organization to better meet its objectives in the year 2000.

Organizational Support

The Internal Revenue Service has already begun to move in profitable directions. Carefully planned strategies are now required to initiate, support, strengthen, and shape the activities which are necessary for full implementation. This study suggests that the optimum way to prepare for the training delivery needs of the next decade is to build deliberately and systematically on foundations that IRS has already laid in the areas of information systems, telecommunications, training technology, and worksystems design.

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APPENDIX

TASK FORCE PARTICIPANTS

Leesburg, Virginia
November 28-30, 1988

National Office Participants

Mr. Ben Dadd	Chief, Office of Training Program Management	HR:H:T
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Mr. Jobe Hugley	Chief, Project Management Section Information Systems Development	IS:P:P
Ms. Judy Bartel	Chief, Personnel and Training Section, Examination	EX:S:PT
Ms. Arlene Tervakoski	Chief, Collection Training	HR:H:T:C
Mr. John Ahearn	Chief, Employee Organization and Development, Collection	CO:M:EOD
Mr. Herb Casey	Acting Chief, Advanced Instructional Systems	HR:H:T:I
Mr. Dave Sohns	Acting Chief, Management and Executive Programs	HR:H:R:M
Mr. Ed Hunter	Program Manager, Advanced Instructional Systems	HR:H:T:I
Mr. John Daugherty	Chief, Product Development Support	HR:H:T:P
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Field Participants

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Mr. Lionel Trepanier	Executive Assistant Regional Commissioner (Collection)	Midwest Region

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Dr. Jim Baker	Director, Automation and Research
Mr. Nick Chandler	Deputy Director, Automation and Research
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Ms. Pat Harris	Senior Research Scientist
Dr. Sharon Tkacz	Senior Research Scientist
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